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EOSDIS Core System Project

Flight Operations Segment (FOS) Operations Tools Manual for the ECS Project

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Hughes Information Technology Systems
Upper Marlboro, Maryland

Flight Operations Segment (FOS) Operations Tools Manual for the ECS Project

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Preface

This document is a formal contract deliverable with an approval code 1. It requires Government review and approval prior to acceptance and use. This document is under ECS contractor configuration control. Once this document is approved, contractor-approved changes are handled in accordance with Class I and Class II change control requirements described in the EOS Configuration Management Plan. Changes to this document shall be made by Document Change Notice (DCN) or complete revision.

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Abstract

This document provides the information needed to operate the operations tools for the Earth Observing System (EOS) AM-1 Flight Operations Segment (FOS) Maintenance and Operations (M&O) portion of the Earth Observing System Data and Information System (EOSDIS) Core System (ECS). It is organized so that general information required by most users is contained in Sections 3 through 7. Section 8 covers material pertinent to users performing scheduling functions. Section 9 details material pertinent to users performing real-time functions. Section 10 covers material pertinent to users performing off-line functions.

Keywords: User's, Manual, Tools, FOT, FOS, Operations, IST, EOC, ECL

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Contents

Preface

Abstract

1. Introduction

1.1 Identification……1-1

1.2 Scope ……1-1

1.3 Purpose……1-1

1.4 Status and Schedule……1-1

1.5 Organization ……1-2

1.6 Conventions ……1-3

2. Related Documentation

2.1 Parent Documents……2-1

2.2 Applicable Documents……2-1

2.3 Information Documents ……2-2

3. FOS Overview

3.1 FOS External Interfaces ……3-1

3.1.1 EDOS Interface ……3-1

3.1.2 NCC Interface……3-2

3.1.3 FDD Interface ……3-3

3.1.4 IP-ICC Interface ……3-9

3.1.5 SDVF Interface ……3-10

3.1.6 Spacecraft Simulator Interface ……3-10

3.1.7 SCF (IST) Interface ……3-10

3.1.8 DAAC Interface……3-10
3.1.9 SMC Interface……3-11
3.2 Flight Operations Services……3-11
3.2.1 Scheduling Phase……3-11
3.2.2 Real-Time Phase……3-11
3.2.3 Analysis Phase……3-12
3.2.4 Support Services……3-12
3.3 FOT Overview……3-12
3.4 FOT Interaction with FOS Services……3-13
3.4.1 Planning and Scheduling Operations and Services……3-14
3.4.2 Command Management Operations and Services……3-14
3.4.3 Command and Telemetry Operations and Services……3-14
3.4.4 Analysis Operations and Services……3-14

4. EOC System Operations

4.1 Introduction……4-1
4.2 Initializing the DEC Polycenter Console Manager……4-1
4.2.1 Hardware Initialization……4-1
4.2.2 Initializing the DEC RAID and RAID Servers……4-3
4.2.3 Sybase Server Initialization……4-4
4.2.4 FOS Software Initialization……4-5
4.3 System Shutdown……4-7
4.3.1 FOS Application Processes……4-8
4.3.2 Hardware Shutdown……4-11

5. Userstation Operations

5.1 UNIX Login……5-1
5.2 FOS Userstation Startup……5-1
5.2.1 FOS Login……5-2
5.2.2 User Roles……5-2
5.2.3 Completion of Initialization……5-5

5.3 Window Management ……5-7
5.3.1 Identify the Active Window ……5-7
5.3.2 Access the Window Menu……5-7
5.3.3 Move a Window ……5-8
5.3.4 Resize a Window ……5-8
5.3.5 Convert a Window to an Icon and Vice Versa ……5-9
5.3.6 Change a Window's Level ……5-9
5.3.7 Workspace Menu ……5-9
5.4 Room Management ……5-9
5.5 Control and Mini Control Windows ……5-9
5.5.1 Enter ECL Directives……5-11
5.5.2 Access Rooms Defined through the Room Builder Tool ……5-11
5.5.3 Switch Between Rooms ……5-11
5.5.4 Control Window Functionality……5-12
5.5.5 Monitor and Acknowledge Event Messages……5-12
5.5.6 Filter Events……5-13
5.5.7 Launch Netscape to a FOS Context Sensitive Help Page……5-14
5.6 System Logout ……5-14

6. Entering ECS Command Language (ECL) Directives

6.1 Entering ECL Directives……6-1
6.1.1 Enter ECL from the Control Window……6-1
6.1.2 Entering ECL from the Command Control Window ……6-2
6.1.3 Entering ECL from the Procedure Control Window ……6-4
6.2 ECL Procedures……6-4
6.2.1 Procedure Builder Tool……6-5
6.2.2 Insert a Procedure into an Open Procedure……6-9
6.2.3 Delete a Procedure……6-9
6.2.4 Print a Procedure ……6-9
6.2.5 Add Directives, Commands, or Telemetry Mnemonics to Procedures with the Directive Builder Tool.……6-9
6.2.6 View Procedure Meta Data ……6-13
6.2.7 Exit the Procedure Builder.……6-13

6.3 Execute a Procedure ……6-14
6.3.1 Execute a Procedure from the Procedure Control Window.……6-14
6.3.2 Execute a Procedure from the Control Window ……6-16
6.3.3 Execute a Procedure from the Command Control Window ……6-16
6.3.4 Procedure Arguments ……6-17
6.4 Submit a Command Request to the Operations Controller ……6-17
6.5 Evaluate a Command Request ……6-21

7. Common Services

7.1 E-mail.……7-1
7.2 Event Message Monitoring.……7-1
7.2.1 View Real-Time Event Messages……7-4
7.2.2 Save and Open Events ……7-4
7.2.3 Access the Event History Archive through Netscape.……7-4
7.2.4 Filtering Events ……7-8
7.2.5 Search for Events……7-11
7.2.6 Timeline Setup ……7-11
7.3 Quick-Message Generator.……7-11
7.3.1 Send a Quick Message ……7-11
7.4 User Customization……7-12
7.4.1 Specify Fonts and Window Colors.……7-13
7.4.2 Associate the Control Window Room Buttons with Rooms ……7-14
7.4.3 Establish the Background Color for Dynamic Pages……7-16
7.4.4 Assign an ECL Directive to a Function Key.……7-17
7.5 Data Mover.……7-18
7.5.1 Copy Local Files to a Local Directory.……7-19
7.5.2 Copy Local Files to a Remote Location……7-21
7.5.3 Copy Files from a Remote Location.……7-22
7.5.4 Delete Local Files……7-24
7.5.5 Close the Data Mover ……7-25
7.6 Document Reader ……7-25
7.6.1 Browse a Document……7-25

7.7 On-Line Help 7-26
7.8 Snapshots 7-27
7.8.1 Take a Snapshot of a Window 7-27
7.9 Display Builder 7-30
7.9.1 Start Display Builder 7-30
7.9.2 Create a New Dynamic Page 7-31
7.9.3 Open an Existing Dynamic Page 7-32
7.9.4 Associate a Logical String with a Dynamic Page 7-34
7.9.5 Add a Display Item, Table or Graph to a Dynamic Page 7-35
7.9.6 Associate a Parameter with a Display Item on a Dynamic Page 7-36
7.9.7 Edit Display Items on a Dynamic Page 7-39
7.9.8 Edit a Field 7-41
7.9.9 Edit a Table 7-43
7.9.10 Edit a Graph 7-44
7.9.11 Save the Dynamic Page 7-49
7.9.12 Add a Dynamic Page to the List of Pages under the Control Window 7-50
7.9.13 Exit the Display Builder 7-50
7.10 Monitor Telemetry on a Dynamic Page 7-50
7.11 Room Builder 7-56
7.11.1 Define a New Room 7-56
7.11.2 Modify an Existing Room 7-58
7.11.3 Switch Between Rooms 7-59
7.11.4 Delete an Existing Room 7-59
7.12 Report Generator 7-60
7.13 Data Replay Controller 7-60
7.13.1 Open a Dynamic Page 7-60
7.13.2 Dedicated Replay 7-61
7.13.3 Shared Replay 7-62
7.13.4 Connect to a Shared Replay Session 7-64
7.14 Schematics Definition 7-64
7.14.1 Compose a Schematic Page 7-64
7.14.2 Customize a Schematic Page 7-67

7.14.3 Monitor Telemetry Mnemonics on a Schematic Page……7-69
7.14.4 Close RTWorks……7-70

8. Scheduling Services

8.1 Scheduling Services Overview……8-2
8.1.1 Scenario For Creating a Schedule for a Typical Day……8-3
8.1.2 Configuration Control of Activities and Constraints……8-7
8.1.3 Background Support Processes……8-7
8.1.4 Typical Scenario for use of Scheduling Tools……8-9
8.1.5 Setting up Run-Time Environment……8-21
8.2 Defining Activities……8-22
8.2.1 Creating an Activity……8-24
8.2.2 Modifying Activity Fields……8-25
8.2.3 Saving an Activity and Saving an Activity as……8-39
8.2.4 Closing the Current Activity……8-39
8.2.5 Deleting an Activity……8-40
8.2.6 Exiting the Activity Definer……8-41
8.3 Defining and Understanding Baseline Activity Profiles……8-41
8.3.1 Defining a BAP……8-42
8.3.2 Scheduling a BAP……8-50
8.4 Using Constraints……8-51
8.4.1 How Constraints Work……8-51
8.4.2 Defining a Constraint……8-55
8.5 Timeline tool: Working With Plans……8-60
8.5.1 Displaying Plans with the Timeline Tool……8-61
8.5.2 Opening Plans……8-62
8.5.3 Closing Plans……8-64
8.5.4 Toggling Between Different Plans……8-64
8.5.5 Creating What-If Plans……8-64
8.5.6 Saving Plans……8-65
8.5.7 Deleting Plans……8-66
8.5.8 Printing a Plan……8-67
8.5.9 Configuring the Timeline……8-69

8.5.10 Controlling Access to Plans Through Permissions 8-77
8.5.11 Viewing Detailed Activity Schedule Time 8-81
8.5.12 Viewing Constraint Information 8-81
8.5.13 Dealing with Merging Plans and Global Visibility 8-82
8.6 Scheduling 8-83
8.6.1 Scheduling an Activity 8-84
8.6.2 Editing a Scheduled Activity 8-94
8.6.3 Alternatives to Using an Activity Definition for Scheduling 8-98
8.6.4 Communications Contact Scheduling 8-100
8.6.5 Uplink Load Scheduling 8-108
8.6.6 Rescheduling Deleted Activities 8-110
8.6.7 Deleting Activities 8-117
8.7 ASTER Filter 8-118
8.7.1 ASTER Polling Process 8-118
8.7.2 Scheduling a Short Term Schedule 8-118
8.7.3 Processing an Analysis Mode STS 8-118
8.7.4 Scheduling a One Day Schedule 8-119
8.7.5 Processing a Late Change 8-119
8.7.6 Processing an Analysis Mode ODS 8-119
8.7.7 Requesting a Portion of the Master Schedule 8-120
8.7.8 Report Detailed Activity Schedule (DAS) Generation 8-120
8.8 Generating Loads 8-120
8.8.1 Generating ATC Loads 8-120
8.8.2 Relative Time Command Sequence (RTS) Loads 8-130
8.8.3 Table Loads 8-135
8.8.4 Microprocessor Loads 8-138
8.9 Validating Database 8-140
8.9.1 Activity Database 8-140
8.9.2 Constraint Database 8-141
8.10 Planning and Scheduling Tips 8-142
8.10.1 Naming Conventions 8-142
8.10.2 Defining Activities 8-142
8.10.3 Defining BAPs 8-144
8.10.4 Constraints 8-144

8.10.5 Scheduling 8-144
8.10.6 Timeline 8-145
8.10.7 Aster Filter 8-145
8.10.8 BAPs 8-145
8.10.9 Recycler 8-145
8.10.10 Event Handler 8-145
8.10.11 Load Generator/Queuer 8-145
8.10.12 FDF Data 8-146

9. Real-Time Services

9.1 Overview 9-1
9.2 Logical String Processing 9-1
9.2.1 Logical String Processing Directives 9-2
9.2.2 Logical String Creation 9-3
9.3 Default Logical String Creation 9-7
9.4 Failure Detection 9-7
9.5 Failure Recovery 9-7
9.6 Connect to a Logical String 9-10
9.7 User Authorization 9-12
9.7.1 Command Authority 9-13
9.7.2 Ground Control Privilege 9-14
9.8 Logical String Disconnection 9-15
9.9 Logical String Deletion 9-16
9.10 Spacecraft Telemetry Processing 9-18
9.10.1 Directives 9-18
9.10.2 Data Decommutation 9-20
9.11 Memory Dump 9-20
9.12 State Check 9-22
9.13 Ground Telemetry Processing 9-22
9.13.1 Directives 9-22
9.13.2 Network Control Center User Performance Data 9-22

9.13.3 Network Control Center Ground Control Message Requests ……9-24
9.13.4 EOS Data and Operations System (EDOS) CODAs……9-27
9.13.5 EOS Data and Operations System (EDOS) Communication Test ……9-27
9.14 Command Processing……9-28
9.14.1 Command Directives……9-29
9.14.2 Real-Time Command Processing ……9-30
9.14.3 Load Processing……9-30
9.14.4 FOP Control and Processing ……9-31
9.14.5 PLOP1/PLOP2 ……9-34
9.14.6 Command Failover Processing……9-35
9.14.7 Execution Verification……9-35

10. Off-Line Services

10.1 Real Time Analysis……10-1
10.1.1 Clock Correlation ……10-1
10.1.2 Solid State Recorder Manager……10-5
10.1.3 The Decision Support System (DSS)……10-9
10.2 Off-Line Analysis……10-12
10.2.1 Build an Analysis Request……10-12
10.2.2 Adding User-Defined Algorithms to an Analysis Request……10-18
10.3 History Processing ……10-24
10.3.1 Spacecraft Telemetry……10-24
10.3.2 Ground Telemetry……10-25
10.3.3 Command ……10-26
10.4 Database Management……10-26
10.4.1 Database Administration……10-26
10.4.2 PDB Processing……10-27
10.4.3 FDF Products Processing……10-32
10.4.4 Database Access……10-33
10.4.5 Database Reports…… 10-101
10.4.6 Database Backups…… 10-115

11. CMS

11.1 Load Generation Tools……11-1
11.2 ATC Load Generation Features……11-1
11.2.1 ATC Safe Activity……11-1
11.2.2 NOOP Command Padding……11-1
11.3 Memory Modeling……11-2
11.3.1 ATC Buffer Display ……11-3
11.3.2 RTS Buffer Display……11-4
11.4 Image Processing……11-4
11.5 CMS Reports……11-5
11.5.1 Dump Report ……11-5
11.6 CMS Products/Naming Convention……11-5

12. EOC File Management

12.1 UNIX Utilities ……12-1

Figures

3.1-1 FOS External Interface Context Diagram ……3-1
3.1.1-1 Real-Time Interface between EDOS and FOS……3-1
3.1.1-2 Offline Interface between EDOS and FOS……3-1
3.1.2-1 Real-Time Interface between NCC and FOS……3-2
3.1.2-2 FOS Planning and Scheduling Interface with NCC ……3-2
3.1.3-1 FDD Management Process ……3-6
3.1.3-2 DMS Ingests FDD Products……3-7
3.1.3-3 CMS Table Load Generation……3-7
3.1.3-4 ANA Generation of Statistics and Datasets……3-8
3.1.3-5 PAS Ingests FDD Data……3-8
3.1.3-6 DMS FTPs Files to ISTs ……3-9
3.1.8-1 Data Archival at the DAAC ……3-10

5.2.1-1 FOS Login Window……5-2
5.2.2-1 User Roles Window……5-3
5.2.3-1 Execution of the UserStationStartup Script……5-6
5.2.3-2 Window after Initializing the FOS Toolkit on the User Station……5-7
5.3-1 Generic Motif Window Manager Windows……5-8
5.5-1 Control Window……5-10
5.5-2 Mini Control Window……5-10
5.5.1-1 Error Dialog Box……5-11
5.5.4-1 Tool Selection Dialog Box……5-13
5.5.6-1 Event Filter Dialog Box……5-14
6.1.1-1 Control Window……6-1
6.1.1-2 Mini Control Window……6-2
6.1.2-1 Command Control Window……6-3
6.1.2-2 Command Control Dialog Box……6-3
6.2.1-1 Procedure Builder Window……6-5
6.2.1-2 File Selection Dialog Box……6-7
6.2.1-3 Find/Replace Dialog Box……6-8
6.2.5-1 Directive Builder Window……6-10
6.2.5-2 Selection Filter Dialog Box……6-11
6.2.6-1 Meta Data Dialog Box……6-13
6.3.1-1 Procedure Control Window……6-15
6.4-1 Command Request Window……6-18
6.4-2 Command Request Creation Window……6-19
6.4-3 Directive Builder Window……6-19
6.4-4 Command Request Evaluation Window……6-20
6.4-5 Command Request Rejection Dialog Box……6-21
6.5-1 Command Request Window……6-22
6.5-2 Command Request Evaluation Window……6-22
6.5-3 Rejection Dialog Box……6-23

7.2-1 Event_Display-Local Window 7-2
7.2-2 Event_Display-Global Window 7-3
7.2.3-1 FOS Event History Form 7-6
7.2.3-2 FOS Event History Report 7-7
7.2.4.1-1 Event Type Filter Dialog Box 7-8
7.2.4.1-2 Subsystem Filter Dialog Box 7-9
7.2.4.1-3 Spacecraft ID Filter Dialog Box 7-10
7.2.4.1-4 String ID Filter Dialog Box 7-10
7.3.1-1 Quick Message Generator 7-12
7.4-1 User Customization Window 7-12
7.4.1-1 Application Colors and Fonts Customization Window 7-14
7.4.2-1 Room Customization Window 7-15
7.4.3-1 Dynamic Page Color Intensities Customization Window 7-16
7.4.4-1 ECL Directives Customization Window 7-18
7.5-1 Data Mover Window 7-19
7.5.1-1 Data Mover Send Window 7-20
7.5.3-1 Data Mover Receive Window 7-23
7.5.3-2 Data Mover Local Directory Selector Window 7-24
7.7-1 FOS Overview Help Page 7-27
7.8.1-1 xv Window 7-29
7.8.1-2 xv controls Window 7-29
7.8.1-3 xv save Window 7-30
7.9.1-1 Display Builder Windows (Palette, Format, Data Sources, Dynamic Page, and Console) 7-31
7.9.2-1 Display Builder Palette Window 7-32
7.9.3-1 Open Dialog Box 7-33
7.9.3-2 Display Builder Console Window 7-34
7.9.4-1 Dynamic Page Logical String Management Window 7-35
7.9.6-1 Display Item Parameter Selector Dialog Box 7-36

7.9.6-2 Selection Filter Dialog Box……7-37
7.9.6-3 Display Item Parameter Selector Dialog Box……7-38
7.9.6-4 Display Item Data Sources Window……7-39
7.9.6-5 Update Rate Dialog Box……7-39
7.9.7-1 Display Item Format Window……7-40
7.9.7-2 Display Item Format Window……7-41
7.9.8-1 Display Item Format Window……7-42
7.9.9-1 Display Item Format Window……7-43
7.9.9-2 Dynamic Page Containing a Table……7-44
7.9.10-1 Display Item Format Window……7-46
7.9.10-2 Display Item Format Window……7-47
7.9.10-3 Display Item Format Window……7-48
7.9.10-4 Display Item Format Window……7-49
7.10.1-1 Data Source Selector ……7-52
7.10.2-1 Quick Analysis Window……7-54
7.10.2-2 Graph Custom Dialog Box ……7-56
7.11.1-1 Room Builder Window ……7-58
7.13.1-1 Data Replay Window……7-61
7.14.1-1 RTWorks Window ……7-65
7.14.1-2 Compose Window……7-67
7.14.2-1 RTDraw Window……7-68
7.14.3-1 Schematic Page ……7-70
8.1-1 Flow of Scheduling Products Through the System ……8-2
8.1.1-1 Scenario for Creating Mission Schedule for a Typical Day……8-4
8.1.1-2 Overview of Planning and Scheduling Tools ……8-6
8.1.4.2.1.4-1 Instrument Footprint Model ……8-12
8.2-1 Activity Definer Window ……8-24
8.2.1-1 New Activity Dialog Box……8-25
8.2.2.1-1 Open Activity Dialog Box ……8-26

8.2.2.2-1 Commands Dialog Box 8-28
8.2.2.3-1 Parameters Dialog Box 8-29
8.2.2.4-1 Modes Dialog Box 8-31
8.2.2.5-1 Complex Activities Dialog Box 8-33
8.2.2.6-1 NCC Code Input Dialog Box 8-34
8.2.2.7-1 ECL Directives Dialog Box 8-35
8.2.2.8-1 Command Procedures Dialog Box 8-36
8.2.2.9-1 Activity Scheduling Information Dialog Box 8-38
8.2.3-1 Save Activity As Dialog Box 8-39
8.2.5-1 Delete Activity Dialog Box 8-40
8.3.1.1-1 BAP Definer Window 8-42
8.3.1.1-2 New BAP Dialog Box 8-43
8.3.1.2.1-1 Open BAP Dialog Box 8-44
8.3.1.2.2-1 Activity List Dialog Box 8-44
8.3.1.2.3-1 Parameters Dialog Box 8-46
8.3.1.2.4-1 Scheduling Information Dialog Box 8-47
8.3.1.4-1 Save As BAP Dialog Box 8-49
8.3.1.5-1 Delete BAP Dialog Box 8-49
8.4.1.4.1-1 During Constraint 8-52
8.4.1.4.2-1 Not During Constraint 8-53
8.4.1.4.3-1 Before Constraint 8-53
8.4.1.4.4-1 Not Before Constraint 8-53
8.4.1.4.5-1 After Constraint 8-54
8.4.1.4.6-1 Not After Constraint 8-54
8.4.2.1-1 Constraint Definer Main Window 8-56
8.4.2.1-2 New Constraint Dialog Box 8-56
8.4.2.2-1 Open Constraint Dialog Box 8-57
8.4.2.4-1 Save As Constraint Dialog Box 8-59
8.4.2.5-1 Delete constraint Dialog Box 8-60

8.5.1-1 Timeline Tool ……8-61
8.5.2-1 Open Plan Dialog Box ……8-63
8.5.5-1 New Plan Dialog Box……8-65
8.5.6-1 Save As Plan Dialog Box……8-66
8.5.7-1 Delete Plan Dialog Box ……8-67
8.5.8.3-1 PostScript Timeline Dialog Box ……8-68
8.5.8.3-2 PostScript Preview Window……8-69
8.5.9.3.1-1 Resource Editor Dialog Box……8-71
8.5.9.4-1 Color Selection Dialog Box ……8-74
8.5.9.5-1 Save Setup Dialog Box ……8-76
8.5.9.5-2 Load Setup Dialog Box……8-77
8.5.10.1-1 Permissions Dialog Box……8-78
8.5.10.1-2 Permissions/Resource Dialog Box ……8-79
8.5.12-1 Soft Constraint Violation ……8-81
8.5.12-2 Hard Constraint Violation ……8-82
8.5.12-3 Constraint Information Dialog Box……8-82
8.6-1 General Scheduler Window……8-84
8.6.1.1.1-1 Time Selection Area of the General Scheduler Window……8-86
8.6.1.1.2-1 Start and Stop Event Radio Buttons……8-87
8.6.1.1.3-1 Stop and Start Time Duration Radio Buttons……8-88
8.6.1.2.1-1 Impact Radio Buttons……8-89
8.6.1.2.2-1 Non-Impact Schedule Radio Buttons ……8-89
8.6.1.2.3-1 Oversubscription Radio Buttons……8-90
8.6.1.3-1 Parameters Dialog Box……8-91
8.6.1.3-2 Floating Parameter Type……8-92
8.6.1.3-3 Enumerated Parameter Type……8-93
8.6.1.4-1 Activity/BAP Definition Dialog Box ……8-94
8.6.2.4-1 Annotation Dialog Box……8-96
8.6.2.5-1 Locked Activity Example……8-97

8.6.3.2-1 Electrical Power Subsystem Command Scheduled on the Master Plan ……8-99
8.6.4-1 Communications Contact Scheduler Window……8-101
8.6.4.2-1 Branch-and-Bound Algorithm Example ……8-104
8.6.4.2-2 Contact Algorithm Parameters Window ……8-105
8.6.5-1 Load Scheduler Window ……8-109
8.6.6-1 Activity Recycler Window……8-111
8.6.6.1.1-1 Activity Recycler Activity Filter Dialog Box ……8-113
8.6.6.1.2-1 Activity Recycler Plan Filter Dialog Box ……8-114
8.6.6.1.3-1 Activity Recycler Resource Filter……8-115
8.6.6.1.4-1 Activity Recycler Time Filter……8-116
8.8.1.1-1 Load Generator DAS Window……8-123
8.8.1.2-1 Load Generator Late Change Window……8-125
8.8.1.3-1 Load Generator Constraint Check Window ……8-126
8.8.1.4-1 Constraint View Dialog Box ……8-127
8.8.1.5-1 Approve or Disapprove Soft Constraints Dialog Box……8-128
8.8.1.8-1 Locking and Unlocking Resources Window……8-129
8.8.2-1 RTS Load Builder……8-130
8.8.2.2-1 Hard Constraint Window……8-132
8.8.2.2-2 Soft Constraint Window……8-133
8.8.2.2-3 RTS Generator Window……8-134
8.8.2.3-1 RTS Load Delete Window……8-135
8.8.3-1 Table Load Builder Window ……8-136
8.8.3.2-1 Table Deletion Window……8-137
8.8.4-1 Binary Load Builder Window……8-138
9.2-1 RTS String Data Display……9-3
9.2.2.1-1 Sample STRING CREATE Directive ……9-4
9.6-1 Data Source Selector ……9-10
9.10.2-1 Telemetry Display Page……9-21
9.14.4-1 Command Parameters Display ……9-33

10-1 Analysis Data Flow Diagram……10-1
10.1.1-1 Clock Correlation Constant Editor Menu……10-3
10.1.2-1 SRR Manager Top Display Window……10-6
10.1.2-2 MODIS Buffer Display Window ……10-7
10.1.2-3 AM-1 SSR Science Status Window……10-8
10.1.3-1 RTie Window ……10-11
10.2.1-1 Analysis Request Window ……10-13
10.2.1-2 Selected Pair Times Window……10-14
10.2.1-3 Pair Time Selector Window ……10-15
10.2.1-4 Analysis Telemetry Selector Window……10-16
10.2.1-5 Selection Filter Window ……10-17
10.2.2-1 Algorithm Registration Window……10-21
10.2.2-2 Algorithm Request Window……10-22
10.2.2-3 Algorithm Input Parameter Mapping Window ……10-23
10.2.2-4 Algorithm Output Parameter Mapping Window ……10-24
10.4-1 Database Utilities (DBA) Page ……10-28
10.4-2 Database Utilities (User) Page ……10-29
10.4.2-1 PDB Validation Page……10-31
10.4.2-2 Operational Data Generation Page ……10-32
10.4.4-1 Database Access Page……10-34
10.4.4.1-1 Activity Log Page……10-35
10.4.4.2-1 FOS Database Events Page……10-37
10.4.4.2-2 Event Definitions Page……10-38
10.4.4.2-3 FOS Event History Page……10-39
10.4.4.3-1 Name Server Page……10-41
10.4.4.4-1 PDB Parameters Page……10-42
10.4.4.4.1-1 Command Parameters Page……10-43
10.4.4.4.1-2 Command Parameter Specification Page……10-46
10.4.4.4.1-3 Command Execution Verification Specification Page ……10-47

10.4.4.4.1-4 Command Fixed Data Specification Page..... 10-49
10.4.4.4.1-5 Command Description Specification Page..... 10-51
10.4.4.4.1-6 Command Prerequisite State Specification Page..... 10-52
10.4.4.4.1-7 Command Variable Data Specification Page..... 10-54
10.4.4.4.2-1 Command Constraints Page..... 10-57
10.4.4.4.2-2 Bit Rule Constraint Page..... 10-58
10.4.4.4.2-3 Comment Rule Constraint Page..... 10-60
10.4.4.4.2-4 No Exist Rule Constraint Page..... 10-61
10.4.4.4.2-5 Offset Rule Constraint Page..... 10-63
10.4.4.4.2-6 Post-Rule Constraint Page..... 10-65
10.4.4.4.2-7 Pre-Rule Constraint Page..... 10-66
10.4.4.4.2-8 Scalar Rule Constraint Page..... 10-68
10.4.4.4.2-9 Subfield Constraint Page 10-70
10.4.4.4.2-10 Subfield Bit Rule Constraint Page..... 10-71
10.4.4.4.3-1 Telemetry Parameters Page..... 10-73
10.4.4.4.3-2 Telemetry Packet Specification Page 10-74
10.4.4.4.3-3 Telemetry Parameter Specification Page 10-76
10.4.4.4.3-4 Telemetry Description Specification Page 10-77
10.4.4.4.3-5 Telemetry EU Conversion Specification Page 10-79
10.4.4.4.3-6 Telemetry Polynomial Coefficients Specification Page 10-82
10.4.4.4.3-7 Red/Yellow Limit Specification Page 10-84
10.4.4.4.3-8 Limit Selection Specification Page..... 10-86
10.4.4.4.3-9 Delta Limit Specification Page 10-88
10.4.4.4.3-10 Discrete States Specification Page 10-89
10.4.4.4.3-11 Context Dependent Specification Page..... 10-91
10.4.4.4.3-12 Derived Telemetry Specification Page..... 10-92
10.4.4.4.3-13 Telemetry Constant Specification Page 10-95
10.4.4.5-1 Parameter Definitions Page..... 10-97
10.4.4.6-1 Spacecraft Orbital Events Page..... 10-98

10.4.4.7-1 System Parameters Page 10-100
10.4.5-1 Database Reports Page 10-102
10.4.5-2 Generate Database Reports Page 10-103
10.4.5-3 PDB Database Reports Page 10-104
10.4.5-4 Load Catalog Database Reports Page 10-105
10.4.5-5 FDF Database Reports Page 10-106
10.4.5-6 View Database Reports Page 10-107
10.4.5-7 View Database Reports Selection Page 10-108
10.4.5-8 Flight Software Load Catalog Report View Page 10-109
10.4.5-9 Print Database Reports Page 10-110
10.4.5-10 Print Database Reports Selection Page 10-111
10.4.5-11 View Database Reports Selection Page 10-112
10.4.5-12 Flight Software Load Catalog Report View Window 10-113
10.4.5-13 Print Database Reports Page 10-114
10.4.5-14 Print Database Reports Selection Page 10-115
10.4.6-1 Database Backups Page 10-116

Tables

3.1.3-1 FDF Products 3-3
4.3.1-1 FOS Application Processes 4-9
5.2.2-1 Capabilities Associated with CAC Role 5-4
5.2.2-2 Capabilities Associated with DBA Role 5-4
5.2.2-3 Capabilities Associated with Generic User Role 5-4
5.2.2-4 Capabilities Associated with Instrument Controller Role 5-4
5.2.2-5 Capabilities Associated with the Operations| Controller Role 5-5
5.2.2-6 Capabilities Associated with the Read Only Role 5-5
5.2.2-7 Capabilities Associated with the PAS Scheduler Role 5-5
5.2.2-8 Capabilities Associated with the PAS Definer Role 5-5

8.6.5.1-1 ECL Uplink Directive Parameters 8-110
8.8.1-1 Load Generation Status Messages..... 8-121
9.2.2.1-1 String Creation/Termination Event Message Text 9-5
9.4-1 Failure Recovery Event Message Text.....9-8
9.5-1 Successful String Failover Event Message Text.....9-10
9.5-2 Unsuccessful String Failover Event Message Text.....9-10
9.6-1 String Connection Event Message Text.....9-12
9.8-1 String Disconnection Event Message Text.....9-16
9.9-1 String Deletion Event Message Text.....9-17
10.4.2-1 ODF Source Generation 10-30

Appendix A. ECS Command Language (ECL)

Appendix B. Event Message Definitions

Appendix C. FOS Ground Parameters

Appendix D. Carry-Out File

Appendix E. Timeline Symbols

Abbreviations and Acronyms

Glossary

1. Introduction

1.1 Identification

The Operations Tools Manual for the Earth Observing System (EOS) AM-1 Flight Operations Segment (FOS) Maintenance and Operations (M&O) portion of the ECS, Contract Data Requirement List (CDRL) item 116, whose requirements are specified in the Data Item Description (DID) 609/OP1, is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract NAS5-60000.

1.2 Scope

This document reflects the February 7, 1996, Technical Baseline maintained by the contractor Configuration Control Board (CCB) in accordance with ECS Technical Direction No. 11, dated December 6, 1994.

1.3 Purpose

This document is intended to provide information needed to operate the Operations Tools of the FOS. The focus of this document is the full complement of FOS Release B capabilities existing at the EOS Operations Center (EOC). The Flight Operations Segment (FOS) Release B Instrument Support Terminal (IST) Toolkit Release Notes, for the ECS Project, White Paper, October 1997 (#343-WP-002-002) and the Flight Operations Segment (FOS) Instrument Support Terminal (IST) Toolkit Installation Guide, White Paper, September 1997 provide information tailored for FOS IST capabilities and installation.

The FOS Release A Version Description Document (VDD), Version 1.02.00, 814-RD-007-007, March 1997, provides a complete description of the FOS Release A system.

This document is organized so that general information required by most users is contained in Sections 3 through 7. Section 8 covers material pertinent to users performing scheduling functions. Section 9 details material pertinent to users performing real-time functions. Section 10 covers material pertinent to users performing off-line functions. Section 11 covers natérial pertinent to users performing command management functions. Section 12 covers file management operations.

1.4 Status and Schedule

This document provides users with material relevant to FOS capabilities.

1.5 Organization

This document is organized as follows:

a. Section 1 provides information regarding the identification, scope, purpose, status, and organization of this document.

b. Section 2 lists documents used as sources as well as supplemental documents.

c. Section 3 provides an overview of the FOS, focusing on high-level operational concepts. This section summarizes the operations staff's key activities and includes an overview of the system in the context of operational activities.

d. Section 4 describes the steps required to both initialize and shutdown EOC hardware and software.

e. Section 5 is an introduction to generic userstation functions.

f. Section 6 is an introduction to the ECS Command Language (ECL).

g. Section 7 focuses on FOS Common Services that all Flight Operations Team (FOT)/Instrument Operations Team (IOT) personnel will need to perform general FOS functions (schedulers, real-time operators, or off-line engineers).

h. Section 8 focuses on services that both the FOT Mission Planner and IOT personnel need to perform scheduling functions.

i. Section 9 focuses on services that the Flight Operations Controller/Shift Supervisors, Spacecraft Activity Controller, Spacecraft Evaluator, and Instrument Evaluator will use.

j. Section 10 focuses on services that the Flight Operations Controller/Shift Supervisors, Spacecraft Evaluator, Instrument Evaluator, and Flight Systems Off-line Engineer will use.

k. Section 11 focuses on the Command Management Subsystem.

l. Section 12 explains EOC file management.

m. Appendix A contains a list of ECL directives and their syntax.

n. Appendix B contains FOS event definitions.

o. Appendix C contains ground telemetry mnemonics and their descriptions.

p. Appendix D contains the Carry-Out file description.

q. Appendix E contains symbols that represent orbital events displayed in the Timeline.

r. The glossary contains key terms included in this document.

s. The alphabetized list of abbreviations and acronyms spells out abbreviations and acronyms used in the document.

1.6 Conventions

The following conventions are employed to differentiate explanatory text from objects displayed on the userstation screen or commands:

a. Items included in a menu are in a bold typeface (i.e., **Open**, **Close Save**).

b. Buttons on window displays, which are activated by positioning the mouse pointer over the button and pressing ("clicking") the left mouse button, are bold, Helvetica typeface (i.e., **OK**, **Close**, **Help**).

c. ECL commands are Helvetica typeface (i.e., START, CONNECT). Values input by the user are Helvetica, italicized typeface (i.e., *MIRROR*, *100*).

d. Buttons on the computer keyboard are delineated by brackets (i.e., <Enter>).

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2. Related Documentation

2.1 Parent Documents

The parent documents are the documents from which this FOS Operations Tools Manual's scope and content are derived.

304-CD-001-003	Flight Operations Segment (FOS) Requirements Specification for the ECS Project, Volume 1: General Requirements.
304-CD-004-003	Flight Operations Segment (FOS) Requirements Specification for the ECS Project, Volume 2: AM-1 Mission Specific.
307-CD-001-003 329-CD-001-003	Flight Operations Segment (FOS) Release Plan and Development Plan for the ECS Project.

2.2 Applicable Documents

The following documents are referenced within this FOS Operations Tools Manual, are directly applicable, or contain policies or other directive matters that are binding upon the content of this document.

209-CD-002-005	Interface Control Document Between EOSDIS Core System (ECS) and ASTER Ground Data System.
814-RD-007-005	Version Description Document, Version 1.01.00.
421-11-19-02	Goddard Space Flight Center, Spacecraft Simulator/EOS Operations Center ICD, October 1996.
505-10-35	Goddard Space Flight Center, DFCD for the EOS AM-1 Project Database, August 1996.
505-41-37	Goddard Space Flight Center, ICD Between ECS and the Version 0 System for Interoperability, March 1996.
505-41-38	Goddard Space Flight Center, ICD Between the ECS and the EOS-AM Project for the AM-1 Spacecraft Analysis System for the ECS Project, March 1996.
540-031	Goddard Space Flight Center, ICD Between the EOSDIS Backbone Network and EOC, September 1996.
510-ICD-EDOS/EGS	ICD Between EDOS and EOS Ground System (EGS) Elements, August 1996.
530-ICD-NCCDS/MOC	ICD Between the Network Control Center Data System and Mission Operations Center, December 1996.

552-FDD-96/010R0UD0 EOS-AM1 Flight Dynamics Division/EOSDIS Core System ICD, October 1996.

2.3 Information Documents

The following documents are referenced herein and amplify or clarify the information presented in this document. These documents are not binding on the content of this FOS Operations Tools Manual.

305-CD-040-002 through 305-CD-049-002 and 305-CD-079-001	Flight Operations Segment (FOS) Release B Design Specification for the ECS Project.
360-TP-001-002	Flight Operations Segment (FOS) COTS Hardware for Release B, Technical Paper for the ECS Project.
604-CD-001-004	Operations Concept for the ECS Project: Part 1 – ECS Overview.
604-CD-002-003	Operations Concept for the ECS Project: Part 2B – ECS Release B.
604-CD-003-002	Operations Concept for the ECS Project: Part 2A – ECS Release A.
605-CD-003-001	Operations Scenario Document for the ECS Flight Operations Segment (FOS).
607-CD-001-002	ECS Maintenance and Operations Position Descriptions for the ECS Project.
612-CD-003-001 through 612-CD-013-001	Flight Operations Segment (FOS) Release B Programmer's Manual for the ECS Project.
RTWorks documentation	RTdraw User Interface Design; RThci Human-Computer Interface; RTie Interface Engine.
Tivoli documentation	TME 10 Framework User's Guide; Tivoli/Sentry User's Guide.
Sybase documentation	Transact-SQL User's Guide.
Altair documentation	Technical Reference for Altair Mission Control System Toolkit; Altair Mission Control System Training Manual.

3. FOS Overview

The ECS FOS is deployed at the EOS Operations Center (EOC) and the FOS Instrument Support Terminal (IST) toolkit. The EOC performs mission planning, commands and controls the U.S. EOS spacecraft and instruments, and coordinates mission operations for other non-U.S. EOS instruments onboard the U.S. spacecraft. EOC operations support the EOS mission life cycle, which includes pre-launch, launch, and on-orbit operations occurring in parallel with operator simulations training, as well as interface tests, system tests, and end-to-end tests; supports concurrent operations with maintenance, system upgrades, and sustaining engineering activities; and simultaneously supports command, control, and analysis of multiple spacecraft and their instruments.

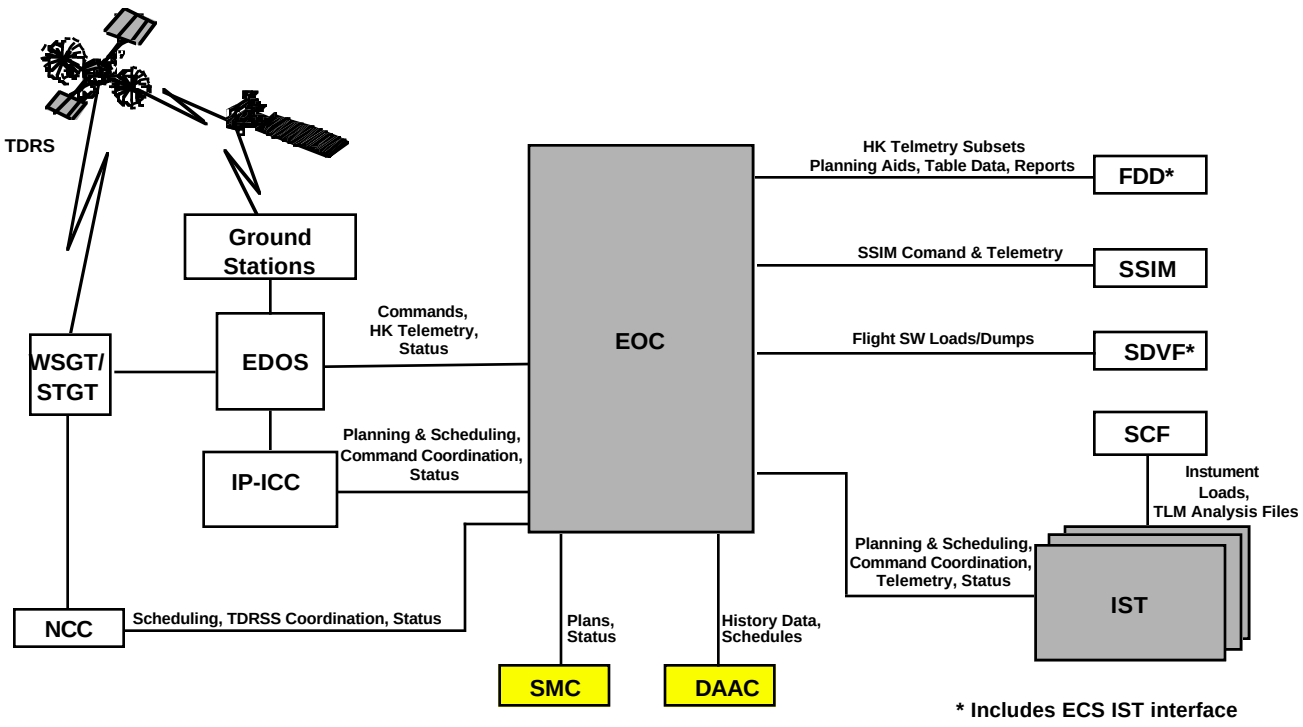
The EOC is located at Goddard Space Flight Center (GSFC) in Greenbelt, Maryland, and is operated by the Flight Operations Team (FOT). The FOT is responsible for: maintaining spacecraft and instrument health and safety; monitoring spacecraft performance; performing spacecraft engineering analysis; performing high-level monitoring of instrument mission performance; and providing periodic reports documenting spacecraft and instrument operations.

Instrument operations are distributed using FOS IST toolkits, which are deployed at instrument Principal Investigator/Team Leader (PI/TL) facilities. IST toolkits enable PI/TLs to remotely participate in planning, scheduling, monitoring, and analyzing their instruments in conjunction with the FOT at the EOC.

1. FOS External Interfaces
2. Flight Operations Services
3. FOT Overview
4. FOT Interaction with FOS Services

3.1 FOS External Interfaces

The FOS context diagram in Figure 3.1-1 shows, at a high level, the relationship between the EOC and its external interfaces. This diagram also shows interfaces between the EOC and other ECS-internal elements [i.e., the ECS Science Data Processing Segment (SDPS) at the GSFC Distributed Active Archive Center (DAAC) and ECS System Monitoring and Coordination (SMC)].



Legend:

EDOS	EOS Data and Operations System	SSIM	Spacecraft Simulator
FDD	Flight Dynamics Division	STGT	Second TDRSS Ground Terminal
HK	Housekeeping	SW	Software
NCC	Network Control Center	TDRSS	Tracking and Data Relay Satellite System
SCF	Science Computing Facility	TLM	Telemetry
SDVF	Software Development and Validation Facility	WSGT	White Sands Ground Terminal

Figure 3.1-1. FOS External Interface Context Diagram

3.1.1 EDOS Interface

EDOS provides the EOC's interface with the Space Network (SN) and ground stations for spacecraft commanding and telemetry operations. The EOC sends spacecraft uplink data, including spacecraft and instrument commands and command loads, to the spacecraft via the EDOS interface. EDOS, in turn, provides the EOC with spacecraft command receipt status, as provided by the spacecraft.

EDOS sends real-time spacecraft and instrument housekeeping telemetry to the EOC. This data is used by the FOT to monitor spacecraft and instrument health and safety during real-time contacts, and to perform command execution verification.

EDOS also sends spacecraft and instrument housekeeping telemetry to the EOC. The rate-buffered service EDOS provides after contact completion.

Data interface status messages are also sent between the EOC and EDOS and are specified in the ICD Between EDOS and EOS Ground System (EGS) Elements. The Real-Time and Offline interfaces between EDOS and FOS are illustrated in Figures 3.1.1-1 and 3.1.1-2 respectively.

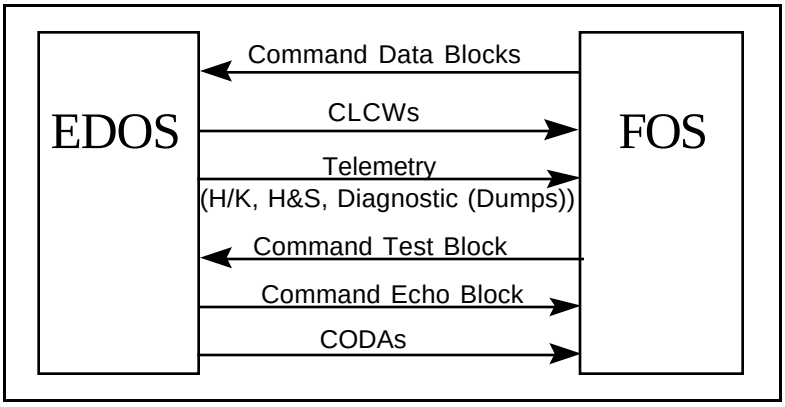


Figure 3.1.1-1. Real-Time Interface between EDOS and FOS

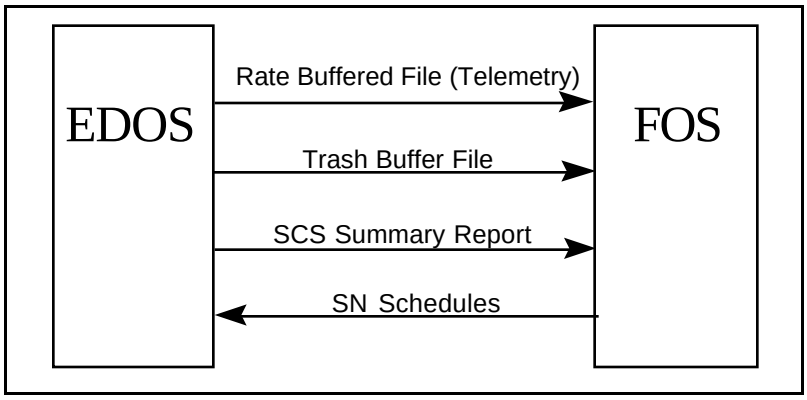


Figure 3.1.1-2. Offline Interface between EDOS and FOS

3.1.2 NCC Interface

The EOC submits Tracking and Data Relay Satellite System (TDRSS) schedule requests and non-telemetry messages (e.g., link reconfiguration requests) to the Network Control Center (NCC). In response, NCC sends TDRSS schedules notifying the EOC of the status of its request and non-telemetry messages (e.g., TDRSS link status messages, performance data).

Data interfaces between NCC and EOC are specified in the Interface Control Document (ICD) Between the NCC Data System and Mission Operations Centers. Real-time interfaces between the NCC and FOS are illustrated in Figure 3.1.2-1; Planning and Scheduling interfaces with the NCC are illustrated in Figure 3.1.2-2.

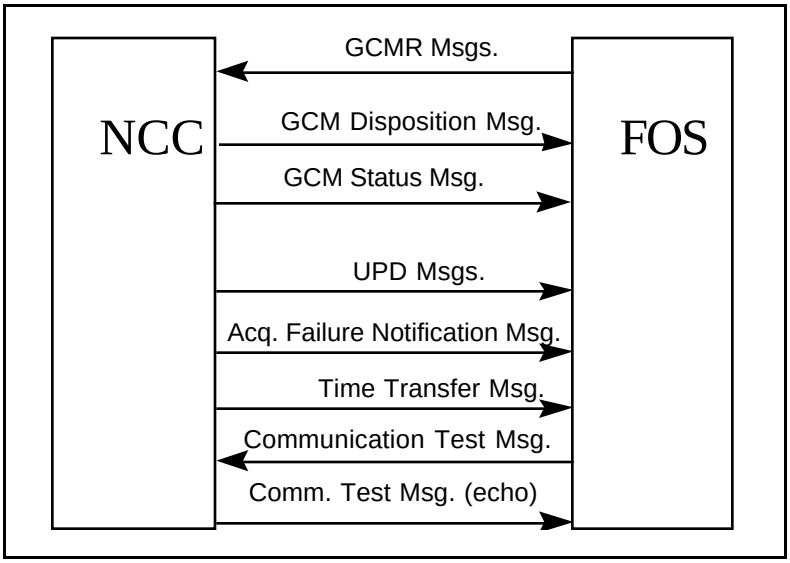


Figure 3.1.2-1. Real-Time Interface between NCC and FOS

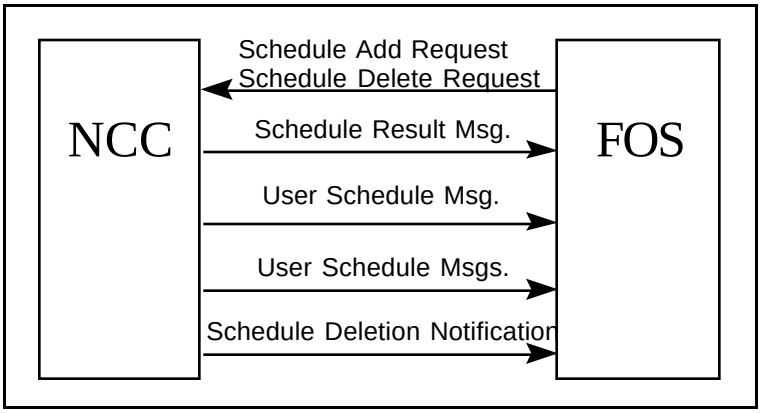


Figure 3.1.2-2. FOS Planning and Scheduling Interface with NCC

3.1.3 FDD Interface

The FDD sends both predicted orbit data and spacecraft contact view period information, and planning aids to EOC for use in spacecraft and instrument planning and scheduling. FDD also develops plans for spacecraft maneuvers in conjunction with EOC and sends spacecraft maneuver parameters to EOC. The FOT schedules and implements these plans. FDD sends FDD parameters needed for spacecraft onboard table generation to the EOC.

EOC provides selected attitude and navigation data parameters to FDD for analysis. This data is a subset of spacecraft housekeeping telemetry nominally captured by EOC during a real-time contact. In addition, back-orbit telemetry subsets may also be sent to FDD from EOC in the form of standard analysis carry-out files.

Data interfaces between FDD and EOC for the AM-1 Mission are specified in the EOS-AM1 FDD/ECS ICD. Table 3.1.3-1 lists FDD products, their filenames, the ICD section that discusses the product's format as well as the end use of the product in FOS. Figure 3.1.3-1 provides an overview of the FDD management process.

Table 3.1.3-1. FDF Products

FDF PRODUCT	FILENAME	ICD SECT	Dataset	Statistics	PAS	FTP ASTER	Table Load	Archived
FSS Transformation Table	FSSTRANS	3.3.3.1					X	X
FSS Calibration Table	FSSCALIB	3.3.3.2					X	X
SSST Transformation Table	SSSTTRANS	3.3.3.3					X	X
SSST Parameters Table	SSSTPARAM	3.3.3.4					X	X
IRU Transformation Table	IRUTRANS	3.3.3.5					X	X
IRU Scaling Table	IRUSCAL	3.3.3.6					X	X
Attitude Slew Table	ATTSLEW	3.4					X	X
EOS Mission Star Catalog	STARCATALOG	3.5					X	X
Star Density Profile	STAR1DENPROF STAR2DENPROF	3.6	X					X
SSST Star Interference	STAR1INTERFER STAR2INTERFER	3.7	X					X
ESA Sun/Moon Interference	ESAINTERFER	3.8	X					X
FSS Visibility Predict	FSSVISPREDICT	3.9	X					X
TDRS State Vectors	TDRS1STATE TDRS2STATE TDRS3STATE TDRS4STATE	3.11	X				X	X
EOS Brouwer-Lynddane Elements	EOSBLELEM	3.12	X	X			X	X
TDRS Brouwer-Lynddane Elements	TDRS1BLELEM TDRS2BLELEM TDRS3BLELEM TDRS4BLELEM	3.13					X	X
Simulated EOS-AM1 Spacecraft Ephemeris	SIMSCEPHM	3.15						X
Filter Tuning Parameters	TUNINGPARAM	3.16	X				X	X
OMNI-to-TDRS Viewing Times	OMNITDRS	3.17	X		X			X
HGA-to-TDRS Viewing Times	HGATDRS	3.18	X		X			X
OMNI-to-Ground Station Viewing Times	OMNIGRND	3.19	X		X			X

Table 3.1.3-1. FDF Products (continued)

FDF PRODUCT	FILENAME	ICD SECT	Data-set	Statistics	PAS	FTP ASTER	Table Load	Arch-ived
HGA Gimbal Angles	HGAGIMBAL	3.20	X		X			X
Predicted EOS-AM1 Ephemeris	EOSEPHM	3.21	X		X	X		X
Predicted TDRS Ephemeris	TDRS1EPHM TDRS2EPHM TDRS3EPHM TDRS4EPHM	3.22	X		X			X
Orbit Adjust Maneuver Request	ORBITMANREQ	3.24						X
Delta-V Parameters Table	DELTAVPARM	3.25					X	X
Mass and Center of Mass Location Estimates	MASSLOCATION	3.26	X	X			X	X
Predicted EOS-AM1 Ranging Data File	FDFRANGE	3.27						X
Attitude Predictions	ATTITUDE	3.28				X		X
Predicted Orbital Events	ORBEVENT	3.29			X	X		X
Planned Orbit Maneuver Dataset	MNVRTIME	3.30			X	X		X
Solar/Lunar Azimuth and Elevation Angle	CERSUNAZEL MISSUNAZEL MOPSUNAZEL MODSUNAZEL CERMOONAZEL MISMOONAZEL MOPMOONAZEL MODMOONAZEL	3.31			X			X
Solar Beta Angles	SOLBETA	3.32			X			X
Predicted Local Sun Time	LOCALSUN	3.33						X
Lunar Beta Angles	LUNBETA	3.34						X
MODIS/MISR Sun and Moon FOV Events	SUNMNFOVEVNT	3.35			X			X
MODIS/MISR Planets/Stars FOV Events	PLSTFOVEVNT	3.36			X			X
Predicted Sub-Satellite Point (Groundtrack)	GRNDTRCK	3.37				X		X
Predicted Spacecraft Altitude	ALTITUDE	3.38						X
Predicted Spacecraft Day/Night Length	DAYNIGHT	3.39			X			X
AM-1 State Error Covariance Matrix	STATEERRCOV	3.40					X	X
Solar/Lunar /Planetary (SLP) Ephemerides	SLPEPHM	3.41						X
Ku-Band Oscillator Frequency Report	OSCFREQREP	3.48	X	X				X
X-band Interference Times	XBANDDSN	3.50			X			X
Apogee/Perigee Altitude File	PERAPALT	3.51			X			X
Predicted Orbit Number and Start Times	ORBITNUM	3.53			X			X
UTC to UT1 Timing Difference	TIMINGDIFF	3.54					X	X
Predicted Instrument Orbit Events	INSTORBEVENT	3.55			X			X

Table 3.1.3-1. FDF Products (continued)

FDF PRODUCT	FILENAME	ICD SECT	Data-set	Statistics	PAS	FTP ASTER	Table Load	Arch-ived
Predicted EOS AM-1 State Vector	EOSSTATEVECT	3.56					X	X
Simulated TDRS State Vectors	SIMTDRS1STAVEC SIMTDRS2STAVEC SIMTDRS3STAVEC SIMTDRS4STAVEC	3.57						X
Simulated EOS AM-1 Brouwer-Lynddane Elements	SIMEOSBLELEM	3.58						X
Simulated TDRS Brouwer-Lynddane Elements	SIMTDRS1BLELEM SIMTDRS2BLELEM SIMTDRS3BLELEM SIMTDRS4BLELEM	3.59						X
Simulated EOS AM-1 State Vectors	SIMSTAVEC	3.60						X
X-Band Ground Station Contact Times	GRNDCONTACT	3.61			X			X
MODIS FOV Target View Period	MODISFOV	3.62			X			X
Earth Gravity Model Spherical Harmonic Coefficient	HARMONICCOEFF	3.63					X	X
Earth Gravity Model Degree Variance	DEGREEVAR	3.64					X	X
Harris-Priester Atm. Density Model Data	MAXDENSMODEL MINDENSMODEL	3.65					X	X
Solar Ephemeris Modification Data	SOLEPHMMOD	3.66					X	X
EOS AM-1 Modeling Data	EOSMODELING	3.67						X
TDRS Modeling Data	TDRSMODELING	3.68					X	X
Ground Antenna Modeling Data	GRNDANT1MODEL GRNDANT2MODEL GRNDANT3MODEL GRNDANT4MODEL	3.69					X	X
State Tolerance Data	STATETOLER	3.70					X	X
Doppler Measurement Tolerance Data	MEASTOLER	3.71					X	X
Covariance Tolerance Data	COVTOLER	3.72					X	X
Navigation Time Step Data	NAVTIMESTEP	3.73					X	X
Phys. and Math. Constants	PHYSCONST	3.74					X	X
Master Oscillator Frequency Bias Data	FREQBIAS	3.76					X	X
Atmospheric Drag Data	ATMOSDRAG	3.77					X	X
TDRS Measurement Bias Data	TDRSMEASBIAS	3.78					X	X
Simulated UTC to UT1 Timing Difference	SIMTIMINGDIFF	3.79						X
Navigation Thruster Table	NAVTHRUSTER	3.80					X	X

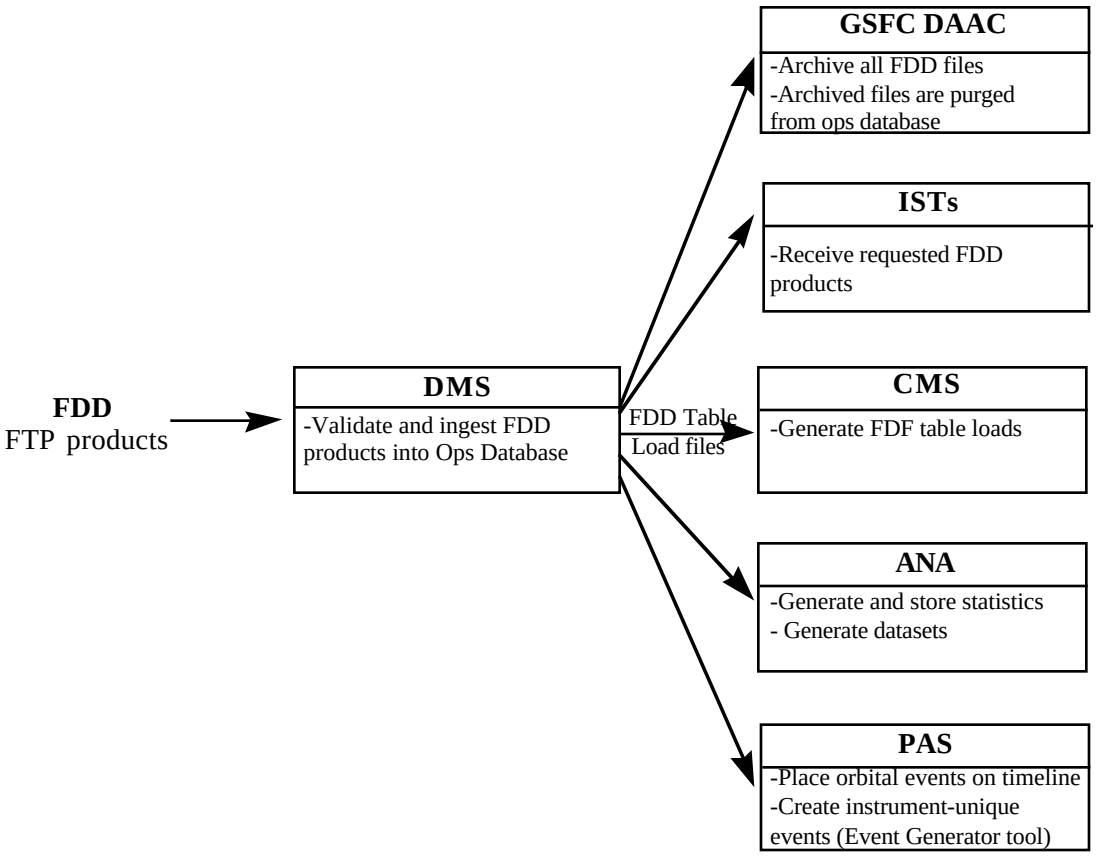


Figure 3.1.3-1. FDD Management Process

The FOS receives, ingests and processes a variety of FDD products. Figures 3.1.3-2 through 3.1.3-6 illustrate the interfaces and products transferred between FDD and FOS. Refer to the EOS-AM1 FDD/ECS ICD for additional information.

The Data Management Subsystem (DMS) receives FDD products and ingests them into the operational database (see Figure 3.1.3-2). The Command Management Subsystem (CMS) generates table loads from FDF table files (see Figure 3.1.3-3). The Analysis Subsystem (ANA) processes the FDD products listed in Figure 3.1.3-4 to generate statistics and datasets. The Planning and Scheduling (PAS) Subsystem utilizes FDD products for updating the Resource Model, a repository of PAS states, schedules and plans. In addition, orbit event data is both placed and updated on the timeline and plans are adjusted by the Schedule Adjustor to reflect changes in event data (see Figure 3.1.3-5). The Event Generator is used to create instrument-unique orbital events (i.e., MISR Local Mode Events, CERES Solar Avoidance Event). Finally, DMS FTPs files to ISTs as illustrated in Figure 3.1.3-6 and provides data to the DAAC for archival (see Section 3.1.8).

Files ingested by DMS are periodically purged, since this data is archived at the DAAC. The FOT can configure the length of time data in the various FDD tables is maintained. This configuration information is in the fos_dbpurge database table.

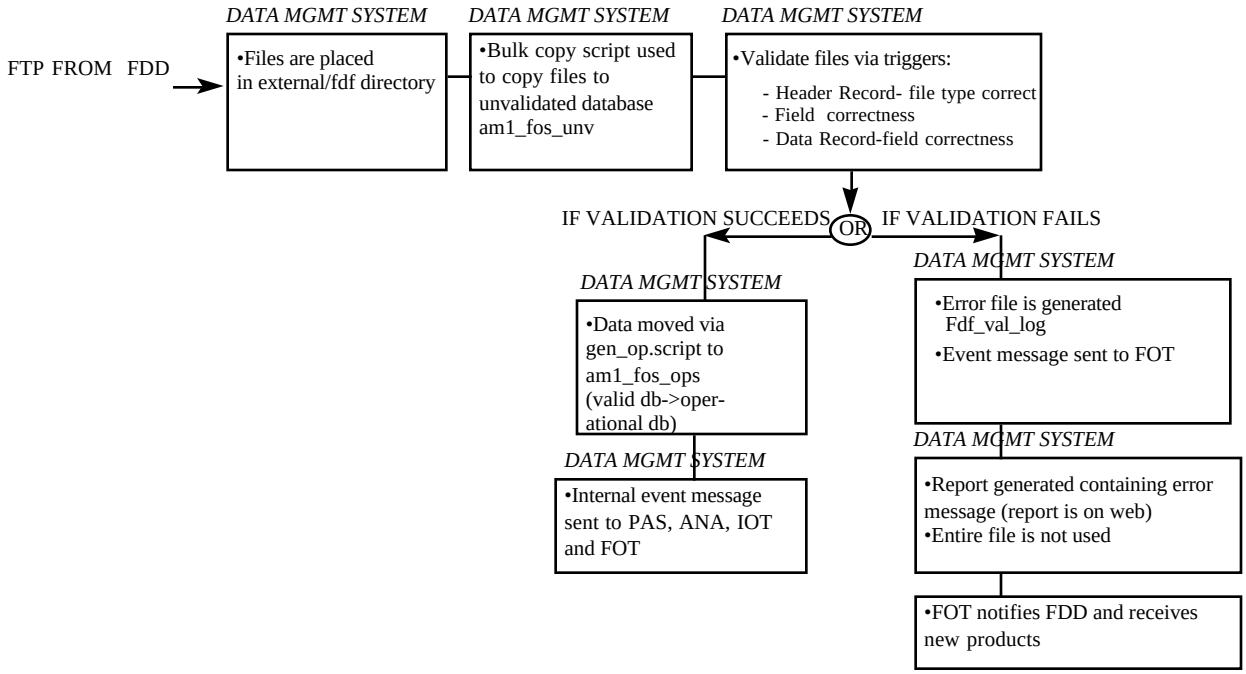


Figure 3.1.3-2. DMS Ingests FDD Products

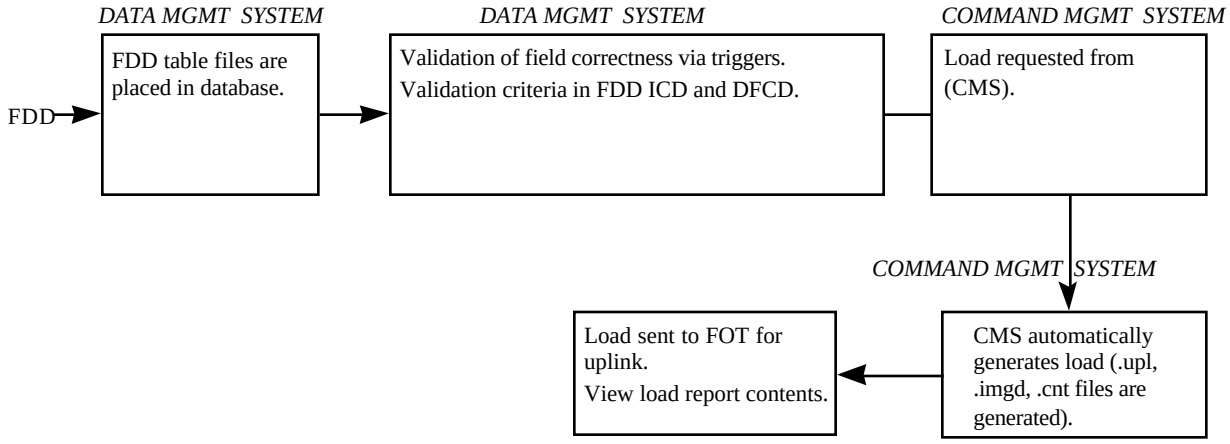


Figure 3.1.3-3. CMS Table Load Generation

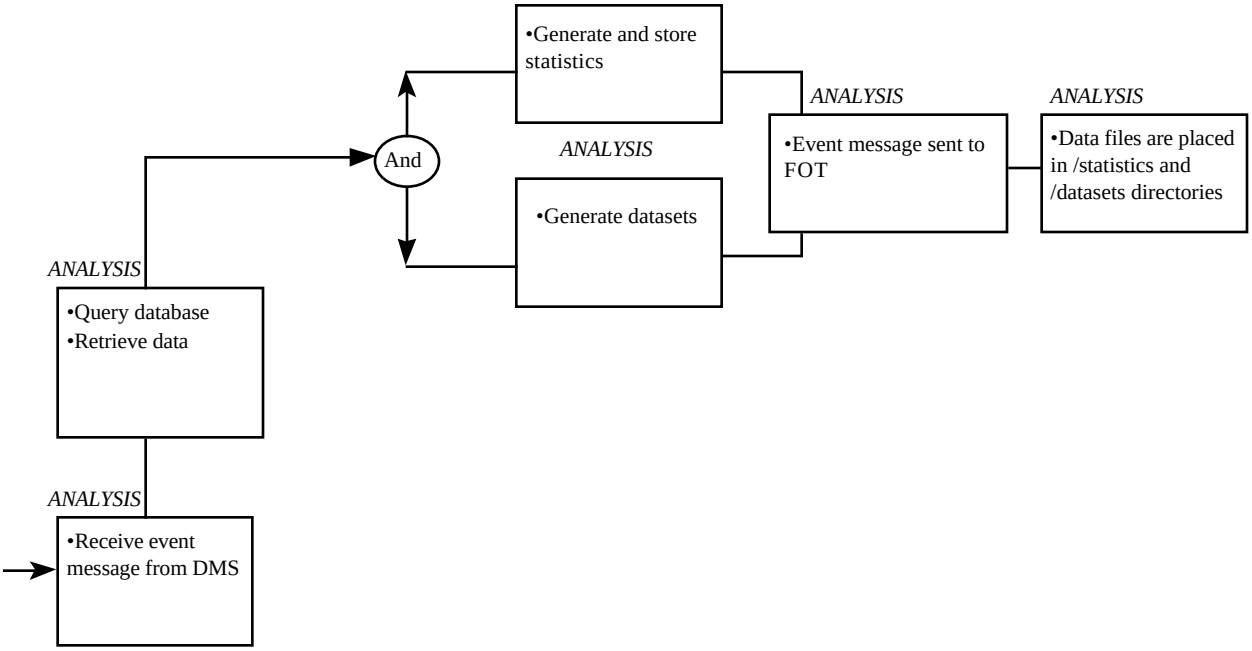


Figure 3.1.3-4. ANA Generation of Statistics and Datasets

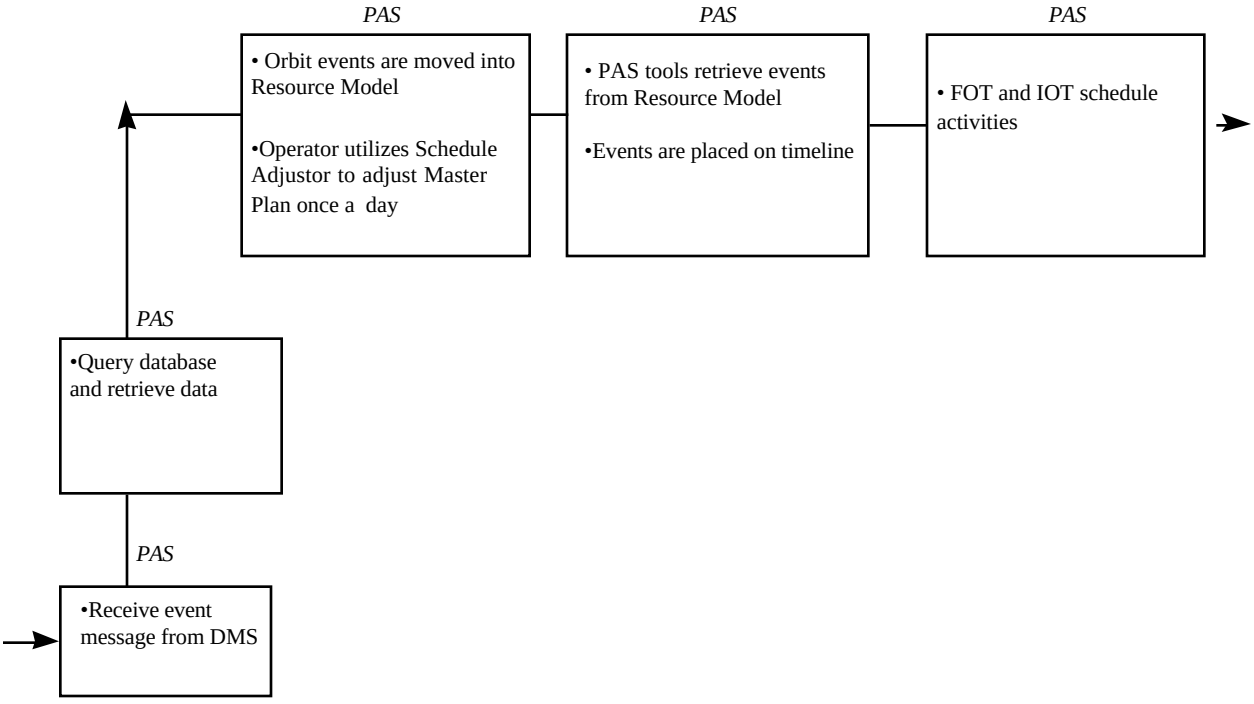


Figure 3.1.3-5. PAS Ingests FDD Data

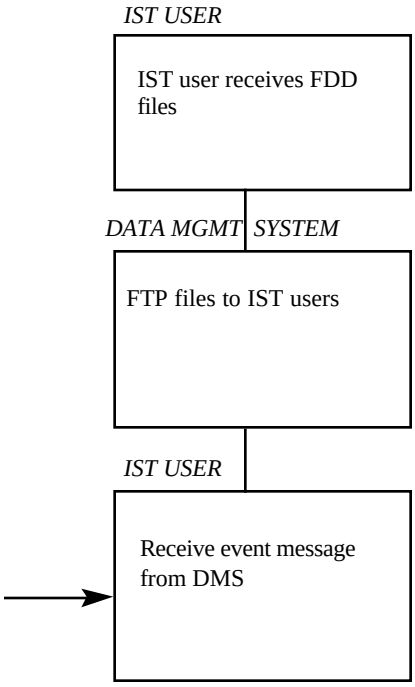


Figure 3.1.3-6. DMS FTPs Files to ISTs

3.1.4 IP-ICC Interface

International Partners (IP) may provide their own Instrument Control Center (ICC) for their instrument onboard an EOS spacecraft. For example, Japan will provide an IP-ICC for the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument onboard the AM-1 spacecraft.

The IP-ICC provides instrument plans and schedules to EOC, and coordinates scheduling conflicts with EOC when they arise. The EOC sends planning aids and integrated mission plans and schedules to the IP-ICC for analysis to refine instrument scheduling.

An IP-ICC can send instrument real-time command requests to the EOC. If approved by the FOT, EOC sends requested commands to the spacecraft via the EDOS interface. The EOC reports on uplink status to the IP-ICC. In addition, EOC can send commands to the spacecraft on behalf of the instrument (e.g., to safe the instrument). The EOC notifies the IP-ICC with a command notification message in this situation.

An IP-ICC can send instrument data base update requests to the EOC. After the database update request has been approved, or whenever a new project database has been established in the EOC, the updated project database will be sent to the IP-ICC.

Periodically, the FOT sends spacecraft and mission status information to the IP-ICC, and the IP-ICC sends instrument status to the FOT.

Data interfaces between the ASTER ICC and EOC are specified in the ICD Between ECS and the ASTER Ground Data System.

3.1.5 SDVF Interface

The SDVF sends flight software loads to the EOC. These loads are scheduled by EOC for subsequent uplink to the spacecraft. The EOC may send flight software memory dumps to the SDVF.

Data interfaces between SDVF and EOC are specified in the ICD Between ECS and the Spacecraft SDVFs.

3.1.6 Spacecraft Simulator Interface

The EOC sends spacecraft and instrument commands to the Spacecraft Simulator. The Spacecraft Simulator sends simulated spacecraft telemetry to EOC. The EOC interfaces with the Spacecraft Simulator via the EOSDIS Test System (ETS) interface. The Spacecraft Simulator is used for flight operations training and development, and to validate operational procedures.

Data interfaces between the AM-1 Spacecraft Simulator and EOC are specified in the Spacecraft Simulator/EOC ICD.

3.1.7 SCF (IST) Interface

Microprocessor memory loads for instruments will be submitted to the EOC from SCF through the IST. These microprocessor memory loads are scheduled by EOC for subsequent uplink to the spacecraft. The EOC sends microprocessor memory dumps to SCF via the IST. The SCF also has a general interface with the EOC through the IST toolkit to import and export other data (e.g., telemetry data files).

3.1.8 DAAC Interface

The GSFC DAAC provides long-term archiving services for flight operations data as illustrated in Figure 3.1.8-1. Data sent to the GSFC DAAC includes spacecraft and instrument housekeeping telemetry, event history data, etc. Additionally, EOC sends mission plans and schedules to the GSFC DAAC. The GSFC DAAC also processes requests for flight operations data that has been previously stored in the long-term archive, and delivers this data to EOC upon request. Refer to the FOS Science Data Processing Segment (SDPS) Data Archive and Retrieval White Paper (document number to be assigned, expected release 12/97) for additional information.

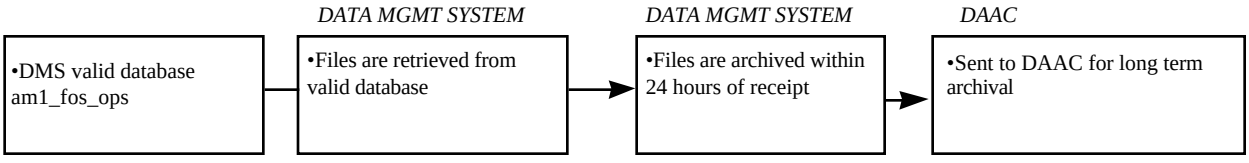


Figure 3.1.8-1. Data Archival at the DAAC

3.1.9 SMC Interface

The SMC sends Long-Term Instrument Plans and Long-Term Science Plans to the EOC. These sets of plans are produced/updated by the Investigator Working Group (IWG) every 6 months and cover a period of up to 5 years.

3.2 Flight Operations Services

Nine services have been defined to support flight operations. These services are: Planning and Scheduling, Command Management, Command, Telemetry, Resource Management, Real-Time Contact Management, Analysis, Data Management, and User Interface. Individually, these services perform specific, unique functions; collectively, they provide a set of interrelated services for the FOT and the IST user community.

Paragraphs 3.2.1 through 3.2.4 are descriptions of the nine flight operations services organized to support the flight operations activity phases.

3.2.1 Scheduling Phase

1. Planning and Scheduling. The Planning and Scheduling service integrates plans and schedules for spacecraft, instruments, and ground operations, and coordinates multi-instrument observations, if necessary. The Planning and Scheduling provides the FOT with a common set of capabilities to perform "what-if" analyses, and to visualize plans and schedules.

   This service allows PI/TLs to actively participate in the EOS mission planning process through the planning and scheduling tools in the IST toolkit. The toolkit provides global visibility into the mission timeline and the set of scheduling products generated at EOC.

2. Command Management. The Command Management service manages pre-planned command data for the spacecraft and instruments. Based on inputs received from the Planning and Scheduling service, Command Management service collects and validates commands, software memory loads, table loads, and instrument memory loads necessary to implement the instrument and spacecraft scheduled activities.

3. Real-Time Contact Management. The Real-Time Contact Management service manages the real-time interface with the NCC and EDOS.

3.2.2 Real-Time Phase

1. Command. The Command service transmits command data (i.e., real-time commands or command loads) to EDOS for uplink to the spacecraft during each real-time contact. Command data can be supplied in real-time by the FOT or as pre-planned command groups generated by the Command Management service. The Command service is also responsible for verifying command execution onboard the spacecraft.

2. Telemetry. The Telemetry service receives and processes housekeeping telemetry [in Consultative Committee for Space Data Systems (CCSDS) packets] from EDOS. After packet decommutation, the telemetry data is converted to Engineering Units (EU) and checked against boundary limits.

3.2.3 Analysis Phase

Analysis. The Analysis service is responsible for managing the on-board systems and for the overall mission monitoring. Its functions include performance analysis and trend analysis. It also cooperates with the Telemetry service to support fault detection and isolation.

3.2.4 Support Services

1. Resource Management. The Resource Management service provides the FOT with the capability to manage and monitor EOC's configuration. This includes configuring EOC resources for multi-mission support; facilitating operational failure recovery during real-time contacts.

2. Data Management. The Data Management service maintains and updates the Project Data Base (PDB) and the EOC history log.

3. User Interface. The User Interface service provides character-based and graphical display interfaces for FOT operators and PI/TLs (using the IST) interacting with all of the aforementioned flight operations services.

3.3 FOT Overview

The ECS FOT will operate the EOC's FOS. The FOT also will operate the EOS spacecraft and instruments, as well as monitor the health and performance of these flight elements, and maintain the FOS system. The FOT consists of four sections (Management, Operations, Flight Engineering, and Ground System Engineering). Specific FOT positions are as follows:

1. **FOT Management**.
   a. Project Support Manager.
   b. FOT Configuration Management (CM) Coordinator.
   c. FOT Performance Assurance (PA) Coordinator.
   d. FOT Training Coordinator.
   e. FOT Administrative Assistant.
2. **FOT Operations**.
   a. FOT Operations Manager.
   b. FOT Operations Coordinator.
   c. FOT Operations Controller/Shift Supervisor.

d. FOT Spacecraft Activity Controller.

e. FOT Mission Planner/Supervisor.

f. FOT Planner/Scheduler.

3. **FOT Flight Engineering**.

   a. FOT Flight Systems Engineer.

   b. FOT Off-Line Engineer.

   c. FOT Spacecraft Evaluator.

   d. FOT Instrument Evaluator.

4. **FOT Ground System Engineering.**

   a. FOT Ground System Engineer.

   b. FOT Database Manager.

For more detailed information regarding FOT responsibilities, refer to the Maintenance and Operations Manual for the ECS Project, 607-CD-001-002.

3.4 FOT Interaction with FOS Services

This paragraph provides a high-level discussion of flight operation concepts and supporting FOS services. For more detailed scenarios describing FOS operations and FOT interactions with FOS services, refer to Operations Scenarios for the ECS Project (FOS), 605-CD-003-001.

EOS spacecraft planning, scheduling, commanding, and telemetry monitoring will be performed by the FOT on a spacecraft-by-spacecraft basis. Parallel but separate configurations (e.g., databases, schedules, commands, and archive files) will be maintained for each EOS spacecraft. The FOT Spacecraft Activity Controller executes ground scripts that send commands and command loads to the spacecraft. Constraints are checked to ensure that only the single authenticated Spacecraft Activity Controller position has authority to send commands to the spacecraft. This approach facilitates concurrent support of multiple spacecraft with different science goals and overlapping TDRSS contacts.

The health and safety of multiple instruments can be monitored by a single FOT Instrument Evaluator due to the nature of the instruments, which are primarily non-complex.

The separate configuration approach is also applied to replacing an EOS spacecraft within a series. For example, separate configurations are maintained for the AM-1 and AM-2 spacecraft. Similarly, this approach enables the FOT to perform ongoing support for spacecraft in-orbit and spacecraft in the operations testing phase. The FOS can be configured so that support of multiple spacecraft in-orbit is physically separated from operations associated with spacecraft in the operations testing phase. This capability provides an additional level of control and security to flight operations.

3.4.1 Planning and Scheduling Operations and Services

The Planning and Scheduling service coordinates and integrates instrument and spacecraft bus command and control requests. It requires cooperative efforts between the FOT planning and scheduling staff, the instrument planning and scheduling staff, and the PI/TL representatives. The PI/TLs interact with the FOT Planner/Schedulers to ensure that their instruments are configured to collect the desired science data and ensure instrument quality. These requests are submitted to Planner/Schedulers as activities. The Planner/Schedulers constraint check submitted activities, assign priorities, and develop a schedule of activities for the instrument. The Planner/Schedulers configure the spacecraft bus subsystems to efficiently use spacecraft resources and execute orbital maneuvers. In addition, Planner/Schedulers integrate instrument and spacecraft subsystem activities into an overall mission schedule. The final Detailed Activity Schedules are available to the PI/TLs through their IST.

3.4.2 Command Management Operations and Services

The Command Management service uses the Detailed Activity Schedule previously developed to generate ground scripts used during a real-time contact with the spacecraft to send commands and command loads, including Spacecraft Controls Computer (SCC) loads and microprocessor memory loads. The Planner/Scheduler integrates this command data, with spacecraft subsystem commands and command loads, into a ground script. In addition to command data, the ground script includes the directives required to configure the ground system to support pre-contact, contact, and post-contact operations.

3.4.3 Command and Telemetry Operations and Services

The Command and Telemetry services provide the Spacecraft Activity Controller the ability to execute the ground script generated for that day's activities by the Planner/Schedulers. The Spacecraft Activity Controller verifies that stored commands are successfully loaded onboard the spacecraft for subsequent execution, as well as the loading and execution of real-time commands. The Spacecraft Evaluator monitors telemetry housekeeping data downlinked from the spacecraft. In parallel, the instrument housekeeping telemetry is monitored by the Instrument Evaluator at the EOC, and/or PI/TL at the IST.

3.4.4 Analysis Operations and Services

The Spacecraft Analysis service provides the FOT Spacecraft Evaluator, Instrument Evaluator, and Off-Line Engineers a set of tools to analyze spacecraft and instrument performance anomalies and deviations from expected performance standards. In particular, Off-Line Engineers routinely analyze housekeeping telemetry trend data concerning spacecraft subsystems to identify performance fluctuation issues (e.g., battery performance). Specific tools aimed at evaluating the functions, resources, and performance of spacecraft subsystems are also routinely exercised by the Spacecraft Evaluator and Off-Line Engineers.

4. EOC System Operations

4.1 Introduction

This section describes how to use the tools that assure appropriate EOC hardware performance as well as how to initialize the Sybase, Real-Time and Data servers. Most parts of this section are intended only for FOS System Administrators. Only paragraphs 4.2.3, 4.2.4, and 4.3 are intended for FOS users. If any part of the initialization process requires *root* access, contact FOS System Administrators.

4.2 Initializing the DEC Polycenter Console Manager

This paragraph describes system initialization functions including: using Digital Equipment Corporation (DEC) Console Managers to access DEC userstations; initializing the Redundant Array of Inexpensive Disks (RAID) system; starting up the Sybase servers; and starting up FOS software. Paragraph 4.3 describes system shutdown including terminating the FOS software and system administrator commands for hardware shutdown. Figure 4.1-1 is the network diagram illustrating the EOC network's layout. Refer to the Segment Level volume of the FOS Release B Design Specification (305-CD-040-002) for a discussion of the EOC network.

4.2.1 Hardware Initialization

The DEC Console Managers must be started first. DEC Polycenter Console Manager software operates the DEC servers. The DEC RAIDs and the RAID Servers (opsraid on either cheetah or lion and supraid on cougar) need to be on-line before any of the other machines. The RAID contains users' home directories and the operational FOS software (in /fos) that needs to be mounted by the other machines. The DEC RAID must be initialized before the RAID Server.

To start the two DEC Console Managers:

1. If not already done, power on the Local Area Transport (LAT) servers by plugging them in. The LAT servers do not have power switches, so to be power-cycled they must be unplugged and re-plugged. The LAT servers are the small, flat boxes with multiple Ethernet connections next to the Console Managers.
2. Power-on the DEC Console Managers and login as the *root* user.
3. In a terminal window on each console, type `console -c3` to start the DEC Polycenter Console Manager (see Figure 4.2.1-1).
4. In the POLYCENTER Console Manager C3 window, select **Console Manager** from the Commands menu, then select **Startup**.

   The DEC server icons will become highlighted. The lights on the LAT servers must also come on for each connected Ethernet cable. If these events do not occur, refer to the FOS EOC Installation Manual to make sure the LAT servers are connected properly to the appropriate Console Manager.

GSFC EOC - ReleaseB HW/Network

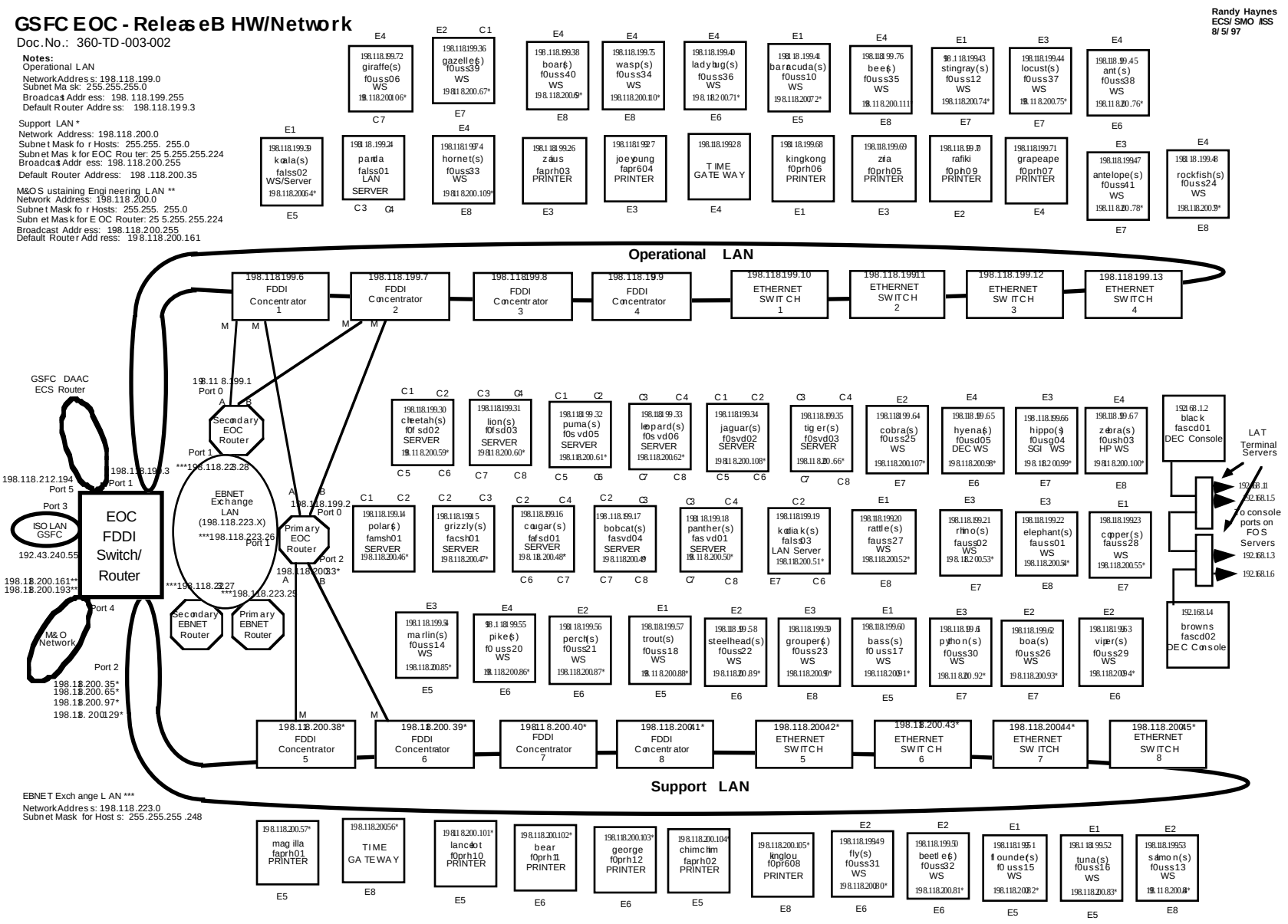
Doc.No.: 360-TD-003-002

Randy Haynes
ECS/ SMO /ISS
8/ 5/ 97

Notes:
Operational LAN
NetworkAddress: 198.118.199.0
Subnet Mask: 255.255.255.0
Broadcast Address: 198. 118.199.255
Default Router Address: 198.118.199.3

Support LAN *
Network Address: 198.118.200.0
Subnet Mask for Hosts: 255.255. 255.0
Subnet Mask for EOC Router: 255.255.255.224
Broadcast Address: 198. 118.200.255
Default Router Address: 198 .118.200.35

M&O Sustaining Engineering LAN **
Network Address: 198.118.200.0
Subnet Mask for Hosts: 255.255. 255.0
Subnet Mask for EOC Router: 255.255.255.224
Broadcast Address: 198.118.200.255
Default Router Address: 198.118.200.161



4.2.2 Initializing the DEC RAID and RAID Servers

Once the Console Managers are up and the DEC Polycenter Console Manager software is running properly, make sure the RAID disks are plugged in. If any disks have an orange or red light on, ensure that the disks are using the **arc** utility.

To run the arc utility:

1. Connect to the RAID Server by double clicking on the appropriate icon in the Polycenter window on the Console Manager connected to the RAID. This brings up a terminal window.

   NOTE

   When other DEC servers are powered-on, users can double click on their corresponding icons in the Polycenter window on the corresponding Console Manager. Each console is connected to specific DECs. Therefore, if a double click on one icon does not connect, try the other Console Manager. If it still does not connect, it indicates that the LAT servers did not properly initialize.

2. When the terminal window opens, press <Return> to receive the login prompt.
3. Login as *root* and type /usr/sbin/shutdown -h now to receive the chevron (">>>") prompt.
4. Type arc to start the utility that sets up the RAID.
5. The **arc** utility only works in 8-bit mode, so in the Terminal window menu, select **Options** and then **General**. This opens a window of options for that terminal window.
6. Select **VT300**, **8-bit Controls**, and **VT220** terminal type.
7. Click **Apply**, but do not save these changes.
8. In the arc utility, choose **Run a program**.
9. Type a:srlmgr to run the RAID software on the 3.5 inch disk currently in the cougar disk drive. If the disk is not there, look for a disk in the RAID cabinet near the Tape Drive Stacker labeled: "StorageWorks, Standalone RAID array, Software version 3.2, for AIX systems." Do not lose this disk! It is required for RAID system initialization.
10. Choose **View Configuration**.
11. Choose **View/Define Drive Group** to display each RAID drive's current state
12. The drive specified "HSP" is the hot spare. Any drives specified "FLD" have failed. To correct this, press <Esc> twice to get back to the Main menu and continue with step 13. If all drives have "OPT" specified, press <Esc> to get out of the arc utility and skip to step 15.
13. Select **Make Optimal** from the Tools menu.

14. Make each drive specified "FLD" to be "optimal" by following the menus and directions. If the drives still do not become optimal, cycle the power to the RAID by unplugging and then re-plugging the unit. Restart the process of running the arc utility. If a drive cannot be made optimal, it must be replaced.

15. After all drives have been made optimal, press <Esc> twice to return to the Main menu, turn the RAID Server off, and then back on. The RAID Server should boot and the RAID disks will be available.

After the DEC RAID and RAID Server are running, all other machines can be turned on in any order.

4.2.3 Sybase Server Initialization

In order to run FOS software, the Sybase Database servers must first be started on the Data servers. This should occur automatically when the machines are powered-on. If for some reason the Sybase servers do not initialize, the following procedure can be used. For passwords or assistance, contact the FOS Data Management Subsystem (DMS) development lead.

To determine if the Sybase servers are running:

1. Login to the Data servers as the user *sybase*.
2. Type cd install to get to the /vendor/sybase/install directory (this is a symbolic link to /usr/sybase/install).
3. Type showserver.
4. If a process similar to /usr/sybase/bin/dataserver -d /usr/sybase/devices/master.dat is shown, then the Sybase server is running.

To start the Sybases servers:

1. Login to the Data servers as the user *sybase*.
2. Type cd install to get to the /vendor/sybase/install directory (which is a symbolic link to /usr/sybase/install).
3. Type startserver -f <*database RUN file*>, where <*database RUN file*> is determined from the following list:

Machine Name	<database RUN file>
panther	RUN_fos1_srvr
jaguar	RUN_ds2_srvr
tiger	RUN_ds3_srvr

4.2.4 FOS Software Initialization

To access FOS applications, first initialize FOS Data and Real-Time servers in the order presented below. Where possible, to facilitate monitoring of system messages, designate a userstation as the initialization userstation and do not run the FOS software on that station.

In order to initialize the Data server, you must log into the machine which is going to run the Data server. This may be done from that machine's console or by logging in remotely. The same is true for a Real-Time server. Once the data server is brought up, a userstation may be started by performing the steps described in Section 5.

4.2.4.1 FOS Data Server Initialization

The FOS software should be operated in the Motif windowing environment. Refer to your specific windowing interface documents for instructions on initializing the Motif windowing environment.

a. Remotely login to the FOS Data server via telnet by placing the cursor in the xterm, CMD or terminal window to make it the active window.

   The system prompt must indicate the new hostname. If not, repeat the login procedure.

b. If necessary, open a xterm, CMD or terminal window.

c. Place the cursor in a second window. Start netscape by entering netscape &.

d. In Netscape, bring up the FOS homepage by selecting FOS Database Page under the Bookmarks menu. If the Bookmark is unavailable, enter the URL for the FOS Database page "http://www.eoc.ecs.nasa.gov/FosDbHome.htm1".

e. On the FOS homepage, under "EOC Test Databases", click on NameServerDatabase. Enter the Data server hostname in the "EntryId" field and click Submit. Verify that no endpoints exist by running the show.sh script from the /fosb/test/am1/scripts/setup directory. If endpoints are found, verify that no other user has started the data server. If necessary, remove endpoints by running the rm_all.sh script at the prompt from the /fosb/test/am1/scripts/setup directory.

NOTE

An alternative to viewing endpoints in steps 3, 4, and 5 is to run the show.sh script from the scripts/setup directory by entering the following commands:

cd /fosb/test/am1/scripts/setup

show.sh

f. Terminate any processes running on the Data server by following the steps outlined in paragraph 4.3.1.1.

g. Place the cursor in a second window. Change to the FOS software setup directory and run the Data server startup script.

cd /fosb/test/am1/scripts/setup

source DataServerStartup

System messages will scroll showing the loading sequence.

h. Enter the Data server hostname in the "EntryId" field and click **Submit**. Verify that there are 76 endpoints. After initializing the Data server, if the Name server form is submitted without a hostname in the "EntryId" field, 126 endpoints will be returned. These include 76 registered with the Name server and 50 registered with IP addresses.

   If the number of endpoints is not 76, type MyKill at the prompt from the /fosb/test/am1/scripts/setup directory to terminate the processes running on the Data server. Repeat steps 6 through 8 to restart the FOS Data server.

NOTE

The correct number of endpoints registered with the Real-Time and Data servers will change over time as software patches are delivered. Check with the FOT System Administrator for the current number of endpoints that should be registered after each server is initialized.

i. To further ensure proper initialization, check processes by remotely login to the FOS Data server via telnet and typing **ps -ea |more**. Verify that all processes listed in Table 4.3.1-1 appear.

4.2.4.2 FOS Real-Time Server Initialization

After initializing the FOS Data server, perform the following steps to initialize the FOS Real-Time server.

a. In the active terminal window, remotely login to the FOS Real-Time server via telnet.

   The system prompt must indicate the new hostname. If not, repeat the login procedure.

b. Place the cursor in a second window. Start netscape by entering netscape &.

c. In Netscape bring up the FOS homepage by selecting FOS Database Page under the Bookmarks menu. If the Bookmark is unavailable, enter the URL for the FOS Database page “http://www.eoc.ecs.nasa.gov/FosDbHome.htm1”.

d. On the FOS homepage, under "EOC Test Databases", click on NameServerDatabase. Enter the Real-Time server hostname in the "EntryId" field and click Submit. Verify that no endpoints exist by running the show.sh script. If endpoints are found, verify that no other user has started the Real-Time server. If necessary, remove endpoints by running the rm_all.sh script at the prompt from the /fosb/test/am1/scripts/setup directory.

NOTE

An alternative to viewing endpoints in steps 2, 3, and 4 is to run the show.sh script from the scripts/setup directory by entering the following commands:

cd/fosb/test/am1/scripts/setup

show.sh

e. Terminate any processes running on the Real-Time server by following the steps outlined in paragraph 4.3.1.1.

f. Change to the FOS software setup directory and run the Real-Time server startup script.

```
cd /fosb/test/am1/scripts/setup

source RealTime        ServerStartup
```

System messages will scroll showing the loading sequence

g. On the FOS homepage, under "EOC Test Database Page", click on **NameServerDatabase**. Enter the Real-Time server hostname in the "EntryId" field and click **Submit**. Verify that there are 33 endpoints.

If the number of endpoints is not 33, enter MyKill at the prompt from the /fosb/test/am1/scripts/setup directory to terminate the processes running on the Real-Time server. Repeat steps 5-7 to restart the Real-Time server.

h. To further ensure proper initialization , check processes by remotely login to the FOS Real-Time server via telnet and typing **ps -ea |more**. Verify that all processes listed in Table 4.3.1-1 appear.

4.3 System Shutdown

FOS provides a script to shut down FOS application processes. To shut down FOS applications, execute the MyKill script from the /fosb/test/am1/scripts/setup directory. The script may be executed from a xterm or cmdtool window. The script will take several minutes to complete as each FOS application terminates.

FOS software should be shut down in the following order: Real-Time server, userstations, then Data server.

Enter the following commands to shut down FOS applications:

```
cd /fosb/test/am1/scripts/setup

MyKill
```

In rare cases, some endpoints may not be deregistered from the Data or Real-Time servers after execution of the MyKill script. If endpoints are returned when the EOC Test Database form is submitted, the remaining endpoints should be removed manually.

To check on and remove endpoints from the Real-Time server by running the show.sh and rm_all.sh scripts from the scripts/setup directory:

1. cd /fosb/test/am1/scripts/setup
2. show.sh
3. rm.sh

or

> Open the Name Server Database form by clicking **NameServerDatabase** on the FOS homepage. On the form, enter the Real-Time server's Id in the "EntryId" field, type the password required to manually remove endpoints in the "Remove Password" field and click **Submit**.

The Data server must be brought down prior to removing endpoints. To check on and remove endpoints from the Data server (and those registered with IP addresses) by running the show.sh and rm_all.sh scripts from the scripts/setup directory:

1. cd /fosb/test/am1/scripts/setup
2. show.sh
3. rm_all.sh

or

> Open the Name Server Database form by clicking **NameServerDatabase** on the FOS homepage. On the form, leave the "EntryId" field blank, type the password required to manually remove endpoints in the "Remove Password" field and click **Submit**.

4.3.1 FOS Application Processes

Table 4.3.1-1 lists FOS application processes that should shut down when the MyKill script is run. Any of the processes not shut down must be manually terminated.

4.3.1.1 Manually Terminate Active FOS Processes

Enter the appropriate UNIX ps command to generate an onscreen list of active processes. Depending on the operating system version, the ps command options will vary. If any FOS processes, listed in Table 4.3.1-1, are active after the MyKill script has completed, they must be manually terminated via the UNIX kill command. To manually terminate any remaining active FOS processes, enter the UNIX command kill -2 <pid>, where <pid> is the process ID (pid) of an active FOS process. Type the ps command again to validate the process is no longer active. If a FOS process is still active, type the UNIX command kill -9 <pid>. This command is guaranteed to terminate the process, as long as the process is associated with the user who enters the kill command. Users may only kill processes associated with their user ID. The System Administrator is the only one who can kill processes associated with another user ID.

Table 4.3.1-1. FOS Application Processes

Userstation	Data Server	Real-Time Server
DisplayBuilder.ini	FaCsReportMonitor	FaAlActivityLogMonitor
FaAcCruncher	FdDbActivityArchive	FcCdFormat
FaCcClockCorrelation	FdDbDiskCleaner	FcCmFop
FaDssIE	FdDbEventDbSrv	FcCmXmit
FaFdfAnalysis	FdDbFileMetaServer	FdEvEventHandler
FaIeSSR	FdDbLoadCatSrv	FgEiEdosIn
FaPrEdosNcc	FdDbOrbitEventServer	FgEoEdosOut
FaRmRequestManager	FdDbTableDefSrv	FgGmNccGroundMgr
FaRtDServer	FdDbTlmCataServer	FgSmNccStatusMgr
FdArTlmArchiver	FdDrTlmRetriever	FoNsNameServer
FdDbOdfTable	FdEvEventArchiver	FoPlRequestReceiver
FdDrTlmRetriever	FdEvEventHandler	FrGrStringMgr
FdEvEventHandler	FdEvEventRouter	FrRmResourceMonitor
FdPbPlaybackMerge	FdFwFileWatcher	FrRpRepeater
FoNsNameServer	FdLtLongTermIf	FtDcDecom
FoUaDatabaseCmdLineClient	FdQmQueueMgr	FtMdDump
FoUaEncryptUtility	FdUrUserRolesArchive	FtScStateCheck
FpAdActivityDefiner	FmCcAM1ConstraintATC	FuGsGroundScriptControl
FpArActivityRecycler	FmCcAM1ConstraintAct	upd
FpAvActivityValidator	FmCcAM1ConstraintProc	
FpBdBapDefiner	FmCcAM1ConstraintRTS	
FpCdConstraintDefiner	FmCcDBStartNotifier	
FpCsCommContactScheduler	FmCcDefinitionConstCk	
FpCvConstraintValidator	FmGsGroundSchedule	
FpDdDataDistributor	FmImAM1MemoryImage	
FpEhEventHandler	FmLdAM1LoadCatalog	
FpFsAsterFilter	FmMmAM1SpacecraftModel	
FpGsGeneralScheduler	FoNsNameServer	
FpLgLoadGenerator	FoPsParameterServer	
FpLsLoadScheduler	FoRfReflector	
FpNsNameServer	FoSwNameServerSweeper	
FpPtTimeline	FoTvClient	
FpPvPlanValidator	FoTvGenMapOdf	
FpRmResourceModel	FoTvServer	
FpRpReports	FoUaServer	
FpSaScheduleAdjustor	FpDdDataDistributor	
FrGrStringMgr	FpEhEventHandler	
FrRpRepeater	FpLqLoadQueuer	
FpTlTimeline	FpNiNccIngester	

Table 4.3.1-1. FOS Application Processes (continued)

Userstation	Data Server	Real-Time Server
FtPgPackGen	FpNsNameServer	
FuAdAtcBuffer	FpRmResourceModel	
FuAnAlgReg	FpSuSSRUpdater	
FuAnBuild	FuClParserServer	
FuAnHandler	FuCrCmdRequestHandler	
FuBbBinLoadBuilder	FuSoManager	
FuCcCmdControl	FmScAM1ScheduleController	
FuCrCmdRequest		
FuCsTranslate		
FuCwControlWindow		
FuDbDisplayBuilder		
FuDbWriteDefs		
FuDbWritePms		
FuDmDataMover		
FuEcEnvCtrl		
FuEmMail		
FuEvEvtdis		
FuEvEvtdisLocal		
FuGdGrndDisplayWin		
FuIwDisplay		
FuLbTableLoadBuilder		
FuPbProcBuilderWin		
FuPcProcController		
FuPwProcControlWin		
FuQaQuickAnalysis		
FuQmQuickMsg		
FuRbRoomBuilder		
FuRcReplayController		
FuRdRTSWin		
FuRlRTSLoadBuilderWin		
FuRmWriteRoom		
FuRpReport		
FuSbSOBrowser		
FuScBuild		
FuScDisplay		
FuScHci		
FuTdDynamicPage		
FuTsEventDataFile		

Table 4.3.1-1. FOS Application Processes (continued)

Userstation	Data Server	Real-Time Server
FuUaLogin		
FuUaMakeRoles		
FuUaWriteConfig		
FuUcUserCustomization		
FuUtSessionServer		
FuWcClock		
evtdis.uid		

4.3.2 Hardware Shutdown

Maintenance or software troubleshooting may require hardware shutdown. The method for hardware shutdown is dependent on the type of machine involved. The RAID server and RAID should be shut down last. User stations, Real-Time and Data servers can be shut down in any order.

NOTE

Prior to shutting down a userstation or server, FOS software associated with the hardware should be shut down.

1. **On a Sun machine**, to shut down the hardware immediately, run one of the following commands as the *root* user:

   ```
   /usr/ucb/shutdown -h now
   ```

   ```
   /usr/sbin/shutdown -y -g0 -i0
   ```

   If a delay before shutdown is desired, replace `now` with `+n`, where `n` is some number of minutes, or change the number after `-g` to the number of seconds to wait before shutdown actually occurs.

2. **On a DEC machine**, to perform shutdown immediately, enter the following command as the *root* user:

   ```
   /usr/sbin/shutdown -h now
   ```

   If a delay before shutdown is desired, replace `now` with `+n`, where `n` is some number of minutes.

3. **On a Hewlett Packard (HP) machine**, to perform shutdown immediately, enter the following command as the *root* user:

   ```
   /etc/shutdown -h now
   ```

   If a delay before shutdown is desired, replace `now` with `+n`, where `n` is the number of seconds to wait before shutdown occurs.

   After the systems have shut down, you may turn off the power.

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5. Userstation Operations

5.1 UNIX Login

In order to execute FOS applications, you must first login to the UNIX userstation, initialize the software on the userstation, register with FOS, and select a user role. The UNIX login procedure is similar for all UNIX userstation; a user name and password are entered at the appropriate prompts.

Passwords must be protected to ensure system integrity. Different versions of the UNIX operating system may enforce slightly different standards, but you should adhere to the following rules when selecting a password.

a. Passwords should be a minimum of eight characters.

b. Passwords should not be words that can be associated with a user (e.g., your child's name, favorite sport, your dog's name, etc.).

c. Passwords should not be words that can be found in any dictionary of human language. For example, containing a combination of alphanumeric and special characters.

The user name and password file is maintained by the UNIX System Administrator. Typically, a default password is provided for the initial login. Users change this password the first time they login to the system. The System Administrator is also responsible for deleting old user names and passwords. The mechanism for maintaining user names and passwords is described in the platform-specific documentation for the network.

After a correct user name/password is entered, the window manager starts. For FOS applications, the Motif window manager (i.e., mwm) must be used. Check with the System Administrator to verify that mwm is being used.

5.2 FOS Userstation Startup

After successfully initializing the FOS Data server (refer to Section 4), userstations can be initialized. It is useful to start a userstation prior to initializing the Real-Time server so event messages about the Real-Time server can be monitored.

a. Click and hold the right mouse button to activate the Workspace menu and select Programs then xterm.

b. At the system prompt enter the following UNIX commands:

   1. cd /fosb/test/am1/scripts/setup

   2. FOS_LOGIN

5.2.1 FOS Login

FOS login involves entering your user name and password in the FOS Login window and selecting a role in the FOS Roles window. See Figure 5.2.1-1. Once FOS software has been initialized on the userstation, the FOS Login window opens. Enter your user name and password and select the environment (**Operational**, **Test**, or **Training**). To use the software in the standalone mode, not connected to the EOC Data or Real-Time Servers, click **Standalone Mode**. Click **OK** to submit your user name and password for user authentication. The user authentication process involves identifying an individual as a recognized user with specific privileges.

Once your user name and password have been authenticated, the User Roles window opens. The user role selected determines the system operations you will be authorized to perform.

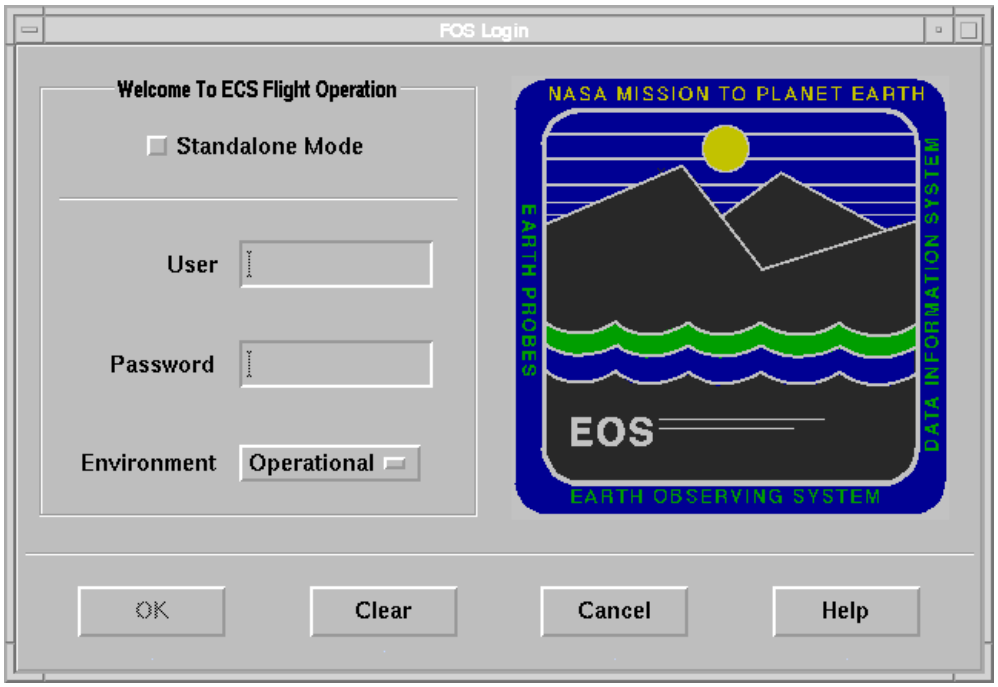

Figure 5.2.1-1. FOS Login Window

5.2.2 User Roles

Once you have successfully logged into the FOS software, the user role you assume determines the system privileges granted. The User Roles window opens automatically once a valid user name and ID are entered via the FOS Login window. Alternatively, the FOS Roles window can be opened by clicking **Tools...** on the Control window and selecting **User Roles** from the list of tools.

Roles are selected by specifying a spacecraft, site, and role on the User Roles window (see Figure 5.2.2-1) and clicking **OK** to submit the role information. The user role selected is checked to confirm that the user is authorized to assume that role for the specified instrument and spacecraft.

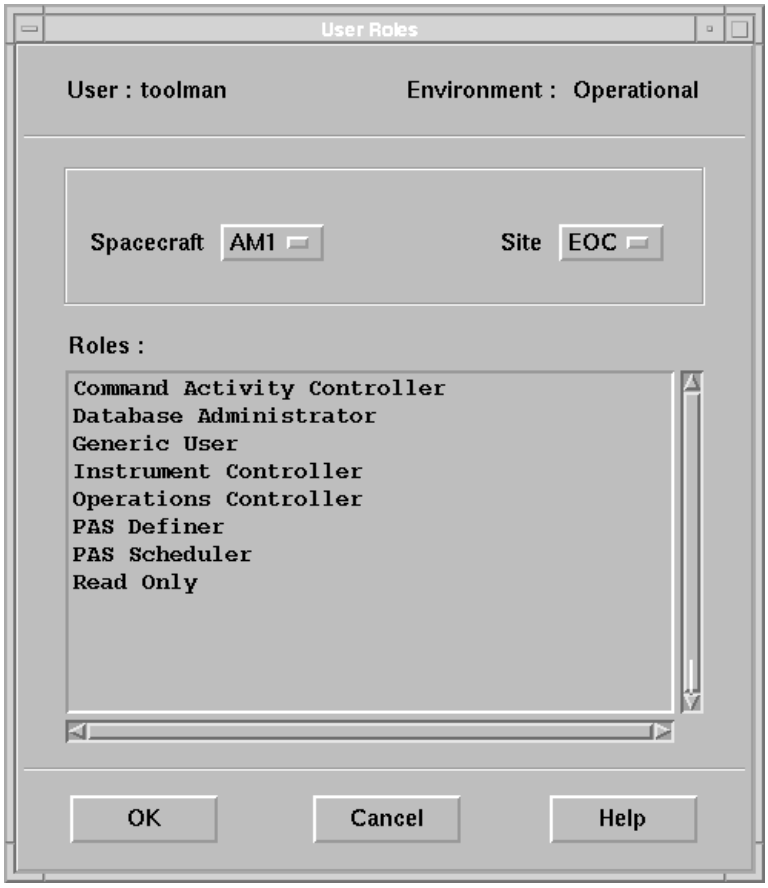

Figure 5.2.2-1. User Roles Window

A user can be authorized to assume multiple roles, with varying privileges determined by the role. Although privileges are instrument-specific, they are not site-specific; in other words an individual authorized to assume the Command Activity Controller role for ASTER can assume the same role at MODIS. The roles a user can assume and the specific privileges associated with a role are defined in the PDB and are updatable. The roles currently defined in the FOS software are listed here, as well as a brief description of the primary function of each role. All of the roles listed below may be assumed at the EOC. ISTs can assume the Generic, Instrument Controller, Read Only, Scheduler, and Definer roles, unless the IST is designated as a "read-only" IST.

a. **Command Activity Controller (CAC)**. Commands the satellite

b. **Database Administrator (DBA)**. Maintains the PDB.

c. **INST Controller (INSTCTRL)**. Oversees spacecraft instrument operation.

d. **Operations Controller (OPSCTRL)**. Responsible for spacecraft and EOC operations.

e. **Scheduler**. Schedules activities.

f. **Scheduling Definer (SCHEDDEFINER)**. Defines and schedules activities.

g. **Generic User**. User who has some system privileges. All roles, except the Read Only role, are authorized to perform tasks which the Generic User role performs.

h. **Read Only**. User with read only access to the system. All roles are authorized to perform tasks the Read Only role performs.

All tools accessed subsequent to selecting a role on the User Roles window are brought up in that role. Consequently, a user may have different roles simultaneously for different tools. In other words, to perform scheduling a user would assume the Scheduler role and open the appropriate scheduling tool. Tools accessed prior to assuming the Scheduler role would remain in the role in which they were accessed. A list of the current tasks associated with each role may be accessed via the FOS home page on the World Wide Web. Tables 5.2.2-1 through 5.2.2-8 identify which FOS capabilities are currently associated with each role.

Table 5.2.2-1. Capabilities Associated with CAC Role

Build rooms	Delete load contents	Generate MPR loads	Schedule FSW loads
Control command	Delete rooms	Generate RTS loads	Schedule MPR
Create command requests	Delete RTS loads	Generate Table loads	Schedule RTS loads
Create RTS loads	Evaluate command requests	Ingest files	
Delete load catalog	Generate FSW loads	Monitor command	

Table 5.2.2-2. Capabilities Associated with DBA Role

Build rooms	Delete load contents	Generate MPR loads	Monitor command
Create command requests	Delete rooms	Generate RTS loads	Schedule FSW loads
Create RTS loads	Delete RTS loads	Generate Table loads	Schedule MPR
Delete load catalog	Generate FSW loads	Ingest files	Schedule RTS loads

Table 5.2.2-3. Capabilities Associated with Generic User Role

Build rooms	Create command requests	Delete rooms	Ingest files
Monitor command			

Table 5.2.2-4. Capabilities Associated with Instrument Controller Role

Build rooms	Delete load contents	Generate MPR loads	Monitor command
Create command requests	Delete rooms	Generate RTS loads	Schedule FSW loads
Create RTS loads	Delete RTS loads	Generate Table loads	Schedule MPR
Delete load catalog	Generate FSW loads	Ingest files	Schedule RTS loads

Table 5.2.2-5. Capabilities Associated with the Operations/ Controller Role

Generate MPR loads	Delete load contents	Generate MPR loads	Monitor command
Control command	Delete rooms	Generate RTS loads	Schedule FSW loads
Create command requests	Delete RTS loads	Generate Table loads	Schedule MPR
Create RTS loads	Evaluate Command Request	Ingest files	Schedule RTS loads
Delete load catalog	Generate FSW loads	Merge command requests	

Table 5.2.2-6. Capabilities Associated with the Read Only Role

Monitor command			

Table 5.2.2-7. Capabilities Associated with the PAS Scheduler Role

Define BAPs	Delete load contents	Generate MPR loads	Schedule loads
Build rooms	Delete rooms	Generate RTS loads	Schedule FSW loads
Schedule contacts	Delete RTS loads	Generate Table loads	Schedule MPR
Create command requests	Filter scheduling	Ingest files	Schedule RTS loads
Create RTS loads	General scheduling	Generate loads/Unlock resources	
Delete load catalog	Generate FSW loads	Monitor command	

Table 5.2.2-8. Capabilities Associated with the PAS Definer Role

Define activities	Define constraints	Filter scheduling	Schedule loads
Define BAPs	Schedule contacts	General scheduling	Generate loads/Unlock resources

5.2.3 Completion of Initialization

Once a user role has been selected, a dialog box appears indicating that the User Station startup script is progressing. System messages will scroll showing the loading sequence (see Figure 5.2.3-1). The script is complete when eight planning and scheduling windows, as well as the Control window are displayed on the screen. Figure 5.2.3-2 shows the initial configuration of the userstation screen once the startup script has completed. The Planning and Scheduling windows can be converted to icons by clicking on the small buttons on the top left corner of each window to conserve space.

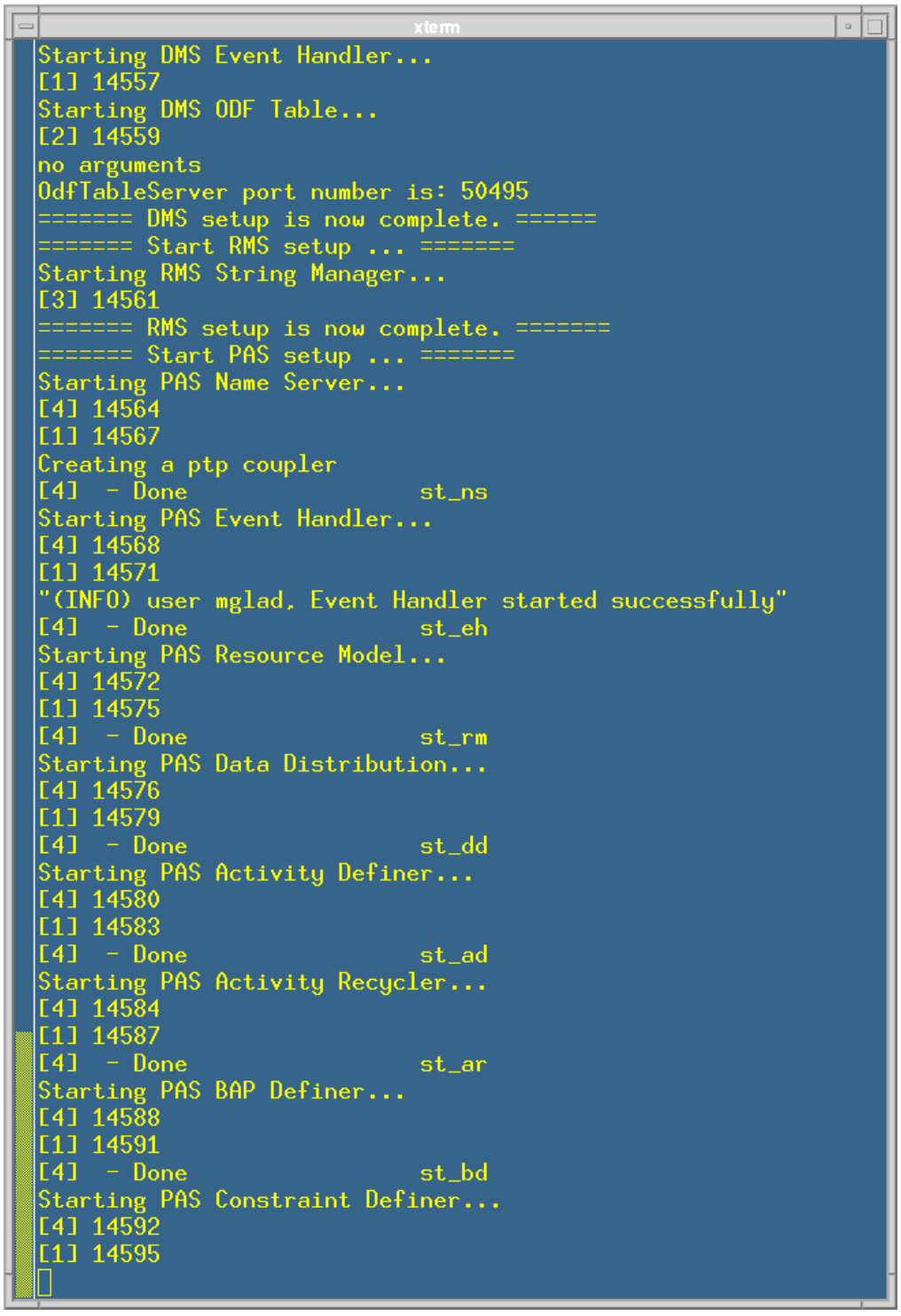

Figure 5.2.3-1. Execution of the UserStationStartup Script

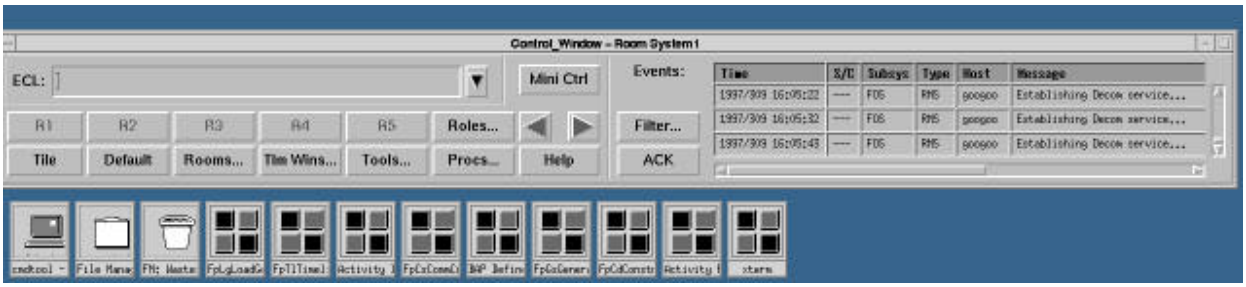

Figure 5.2.3-2. Window after Initializing the FOS Toolkit on the User Station

5.3 Window Management

FOS applications are designed to run on a userstation with Motif window manager (mwm) software installed. Figure 5.3-1 is a generic Motif Window Manager window.

5.3.1 Identify the Active Window

The active window under mwm is determined by the position of the mouse pointer. When you move your pointer over a window, the window's border changes color to indicate it is the active window. Before typing in a window, you must first make the window active. Only one window is active at a time.

5.3.2 Access the Window Menu

Each window has a Window menu enabling manipulation. Click the mouse pointer on the minus sign located in the top left corner of a window to access the Window menu. The Window menu contains the following options:

1. **Move**. Enables you to move the active window.
2. **Size**. Enables you to size the active window.
3. **Minimize**. Converts the window into an icon.
4. **Restore**. Restores an icon to a window (available only for icons).
5. **Maximize**. Resizes the window to fill the screen.
6. **Lower**. Moves the window behind the overlapping open windows on the screen so that it is no longer visible.
7. **Close**. Closes the window and terminates any active processes in the window.

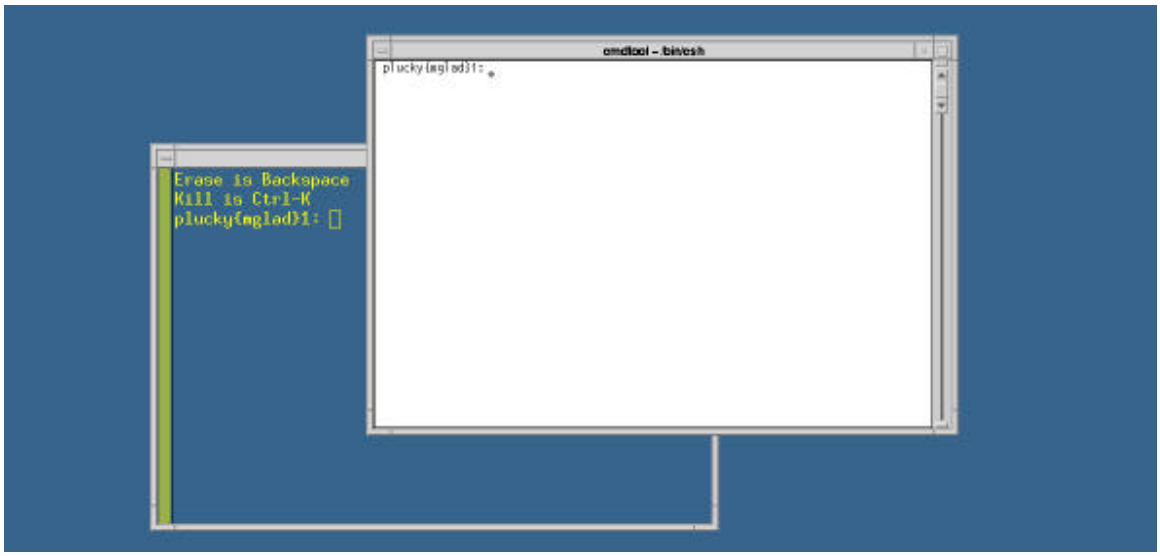

Figure 5.3-1. Generic Motif Window Manager Windows

5.3.3 Move a Window

To move a window by clicking and dragging:

Position the mouse pointer on the window title bar and click and hold the left mouse button. Drag the window to the desired location and release the mouse button.

To move a window using the Window menu move option:

Click and hold the mouse pointer on the minus sign located in top left corner of a window. Select **Move** from the Window menu and reposition the window by dragging it or pressing the arrow keys. Click the left mouse button to deactivate the move function.

5.3.4 Resize a Window

You can resize a window by clicking one of its borders or corners and dragging or by selecting **Size** from the Window menu.

To resize a window by clicking and dragging:

To change the window's width, click and hold the left mouse button on the left or right window border. Drag the border to the desired location and release the mouse button. To change the window's height, click and hold the left mouse button on the top or bottom window border. Drag the border to the desired location and release the mouse button. To resize the width and height of the window simultaneously, click and hold the left mouse button in any corner of the window and drag.

To resize a window using the Window Resize menu option:

Click and mouse pointer on the minus sign located in top left corner of a window. Select **Size** from the Window menu and press the left/right arrow keys to change the width and the up/down arrow keys to change the height. Click the left mouse button to deactivate the resize function.

5.3.5 Convert a Window to an Icon and Vice Versa

Convert the active window to an icon by clicking the top right button containing the small dot or by selecting **Minimize** from the Window menu. Restore an icon to a window by positioning the mouse pointer on the icon and double clicking the left mouse button or by selecting **Restore** from the Window menu.

5.3.6 Change a Window's Level

Raise a window to the top level of open, overlapping windows on the screen by clicking its border with the left mouse button. Move a window behind the open windows on the screen so that it is no longer visible by selecting **Lower** from the Window menu.

5.3.7 Workspace Menu

The default Motif Workspace menu contains the window management options. To access the Workspace menu, click and hold the right mouse button on an empty area of the desktop. The Workspace menu can be customized by editing the .mwmrc file in your home directory; refer to the Motif window manager documentation for instructions on customizing the file.

5.4 Room Management

The FOS desktop consists of a set of one or more windows grouped together into a room. A room is a group of one or more windows saved under a room name. The windows comprising a room definition are called pages, and may be tools or dynamic pages. The Control window is persistent in every room. The initial room configuration when software is initialized consists of a single window (the Control window). The Control window enables you to access rooms, tools and dynamic pages; manage windows; enter ECL directives; and monitor, filter, and acknowledge events. Planning and Scheduling windows are activated when software is initialized including the Activity Definer, Baseline Activity Profile (BAP) Definer, General Scheduler, Load Generator, Activity Recycler, and Timeline.

5.5 Control and Mini Control Windows

The Control window (see Figure 5.5-1) is persistent or active in all rooms and provides a mechanism for selecting tools, entering ECL directives, displaying real-time events, and accessing telemetry and ground system parameter displays. The Mini Control window (see Figure 5.5-2) provides access to a subset of the capabilities of the Control window. This subset of capabilities includes entering ECL directives and accessing the **Tile**, **Default**, **Rooms...**, **Tlm Wins...**, **Tools...**, **Procs...,** and **Help** buttons described in the following text. To switch between the Control and Mini Control windows, click the **Mini Ctrl** button on the Control window or the **Full Ctrl** button on the Mini Control window.

Figure 5.5-1. Control Window

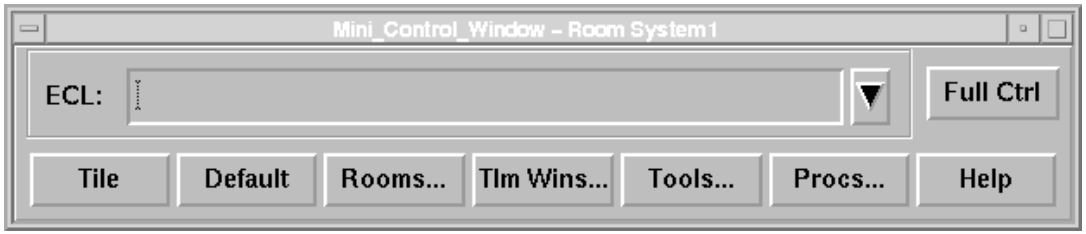

Figure 5.5-2. Mini Control Window

5.5.1 Enter ECL Directives

Enter ECL directives in the ECL command line on the Control or Mini Control windows. Spacecraft commands must be entered via the Command Control window; they cannot be entered on the Control window. Syntax errors are reported via a dialog box (see Figure 5.5.1-1). To view a list containing the last 20 ECL directives, click the arrow button next to the ECL command line. Copy a directive from the list to the ECL command line by selecting it in the list. If necessary, after modifying the directive, execute it by pressing <Return>.

Figure 5.5.1-1. Error Dialog Box

5.5.2 Access Rooms Defined through the Room Builder Tool

Just below the ECL command line is a row of buttons labeled **R1**, **R2**, ..., **R6**. These buttons can be customized to access rooms previously defined through the Room Builder tool. The Room Builder tool enables you to create or modify room definitions, including the number and types of pages in a room, their positions, sizes, and states (tiled or untiled). Refer to Section 7.4 for instructions on customizing room buttons.

5.5.3 Switch Between Rooms

The right and left arrow buttons enable you to switch between open rooms.

1. **Enter the First Room**. Select the name of the room under the **Rooms...** button on theControl window or enter the ROOM directive in the command line of the Control window.

   The room definition opens.

2. **Enter the Second Room**. Select the name of a second room under the **Rooms...** button on the Control window or enter the ROOM directive in the command line of the Control window.

   The first room is not visible. The second room definition is visible on the screen.

5.5.4 Control Window Functionality

The room buttons (**R1** through **R6**) may be customized to access rooms (refer to Section 7.4). The buttons below the room buttons enable you to control the state in which windows are displayed on the screen, and to access rooms, dynamic pages, tools, ECL procedures, and help.

1. **Tile**. Click this button to revert to the tiled definition for the open room. During room creation, the room designer specifies the pages - windows or tools - in the room as well as their size and position. Each room has a tiled and untiled definition, designated when the room is created. Refer to the section on the Room Builder tool for additional information.

2. **Default**. Changes the current room definition to its default state.

3. **Rooms...**. Brings up a dialog box listing room definitions. Select the room definition name from the list to switch to that room definition.

4. **Tlm Wins...**. Opens a dialog box listing telemetry page definitions accessible via the Control window. Refer to the Display Builder section for instructions on creating, modifying, and making user defined telemetry (dynamic) pages accessible via the Control window. Dynamic pages display parameters for vehicles and ground systems. Prior to activating a telemetry page using a string, you must connect to that string by entering the STRING CONNECT directive. Refer to the section on ECL Directives for additional information. Once you have connected to the string(s) associated with a telemetry page, bring up a page definition by selecting it from the list.

5. **Tools...**. Opens the Tool Selection dialog box which provides access to tools, including the Room Builder and Display Builder enabling you to create and modify room and dynamic page definitions. The list of tools can be filtered to include all tools (**All**) or by software subsystem (**Analysis**, **Commanding**, **Load Management**, **Planning & Scheduling**, or **Utilities**). Access a tool by selecting it from the list and clicking **OK** or by double clicking the tool. Figure 5.5.4-1 is the Tool Selection dialog box.

6. **Procs...**. Brings up a dialog box listing ECL procedures. To view system-defined procedures, select **System**. To view user-defined procedures, select **User Defined**. Select a procedure by highlighting it in the list.

7. **Help**. Launches Netscape to a context-sensitive help page.

5.5.5 Monitor and Acknowledge Event Messages

The right side of the Control window contains a scrolling table displaying the three most recent real-time events. Refer to Appendix B for a complete listing of event messages. When event messages are displayed in the Control window, they are color coded as one of four message types: information - black lettering on gray background; warning - black lettering on yellow background; alarm - red lettering on black background; and fatal - white lettering on black background. Alarm messages blink on the screen until acknowledged. To acknowledge an alarm message, click the blinking message in the Control window and click **ACK**.

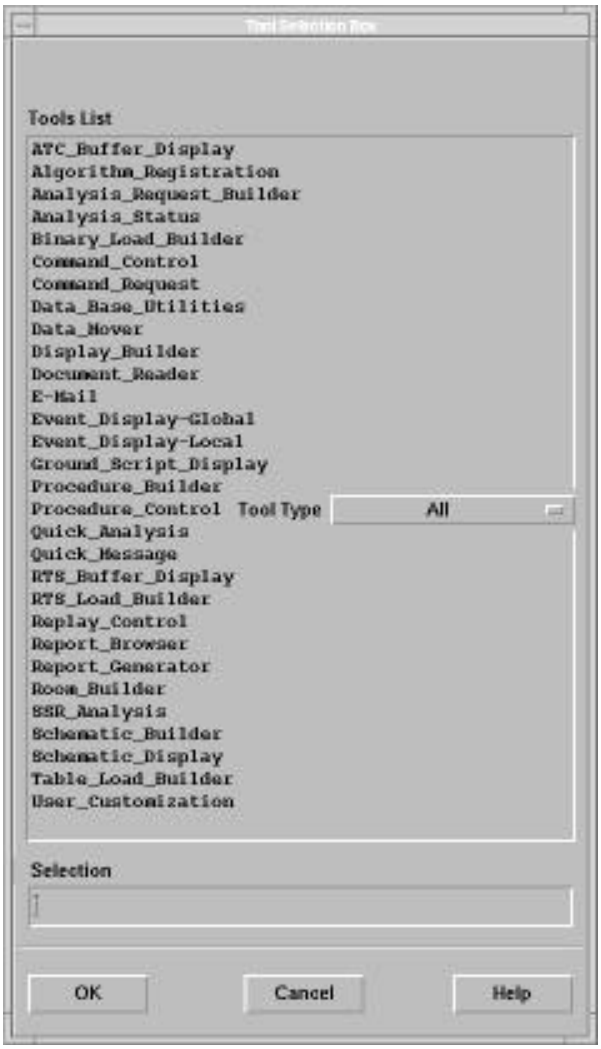

Figure 5.5.4-1. Tool Selection Dialog Box

5.5.6 Filter Events

Events displayed in the Control window and Local and Global Event Display windows may be filtered by spacecraft ID, subsystem event type or string. The event filters are activated by selecting **S/C ID** (spacecraft ID), **Subsystem, Event Type**, or **String ID** from the Filter menu of the Event Display window. Event types reflect the FOS subsystem that generated the event message. Choose any number of filters by selecting or deselecting the corresponding check box. The **All** button selects all filters; **None** deselects all filters for a respective category (subsystem or type). To apply the selected filters to events displayed in the Control window, click **Apply**. Click **Cancel** to discard any filter changes that have not been applied.

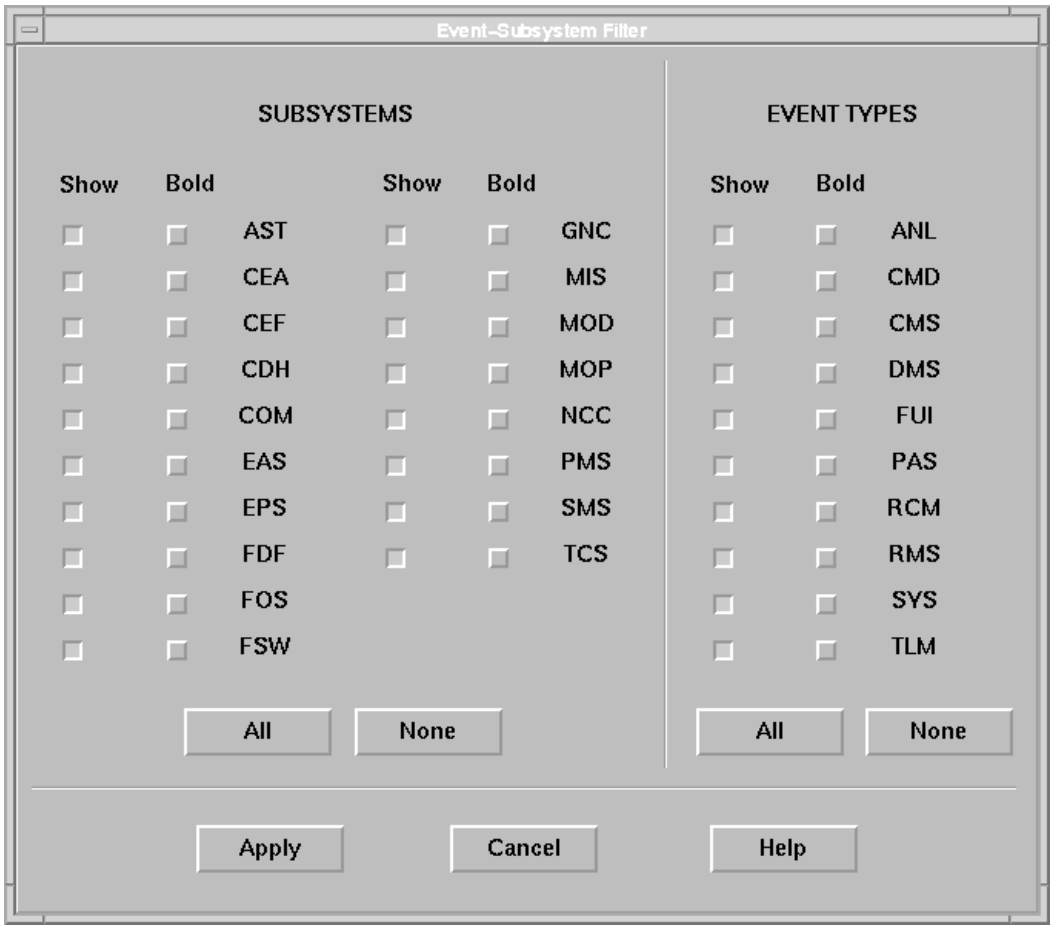

Figure 5.5.6-1. Event Filter Dialog Box

5.5.7 Launch Netscape to a FOS Context Sensitive Help Page

Help launches Netscape to a context-sensitive help page.

5.6 System Logout

To exit UNIX, select **Logout** from the Workspace menu.

6. Entering ECS Command Language (ECL) Directives

6.1 Entering ECL Directives

ECL directives can be manually entered from the Control, Command Control, or Procedure Control window. Directives typed in the command line of a Control window are called manual directives. This section describes how users manually enter and execute ECL directives via Control windows. Command directives are spacecraft commands proceeded by / or CMD, ground directives that effect RCM, RMS, TLM subsystems, which are a subset of ECL, and the remaining ECL are referred to as local directives. See Appendix A for a description of all ECL directives.

6.1.1 Enter ECL from the Control Window

ECL directives can be entered in the ECL command line of either the Control window (see Figure 6.1.1-1) or the Mini Control window (see Figure 6.1.1-2). A directive's syntax is checked when the <Return> key is pressed. If errors are detected, an error message is displayed in a dialog box. Edit the directive in the ECL command line to make necessary corrections. Double click in the text field to highlight the nearest word in the ECL command line; triple click to highlight all text. As you type, highlighted text is replaced.

If a directive passes the syntax check, it is sent to the appropriate FOS subsystem for execution. The amount of time required to execute a directive may vary greatly depending upon the request. For example, creating a new logical string via a STRING CREATE directive may require several minutes. Monitor the Event Message window to follow the progress of the directive. Subsequent directives may be entered in the Control window's ECL command line while the initial directive executes.

Command directives cannot be entered from the Control window, only ground directives and local directives can be executed. To execute ground directives the user must be connected to a real-time logical string control authority; next, the user has to request ground authority by entering the TAKE GROUNDCONTROL STRING <stringid> directive, where stringid is the current logical string.

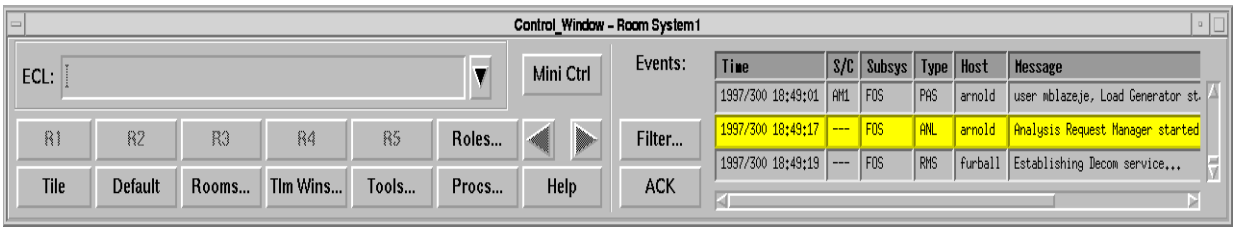

Figure 6.1.1-1. Control Window

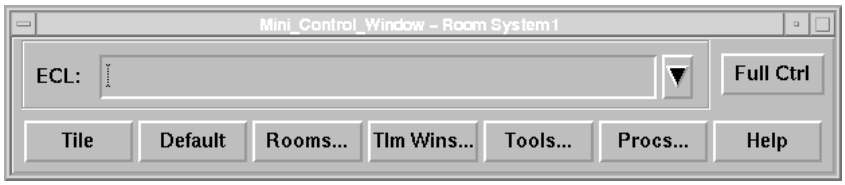

Figure 6.1.1-2. Mini Control Window

6.1.2 Entering ECL from the Command Control Window

The Command Control window (see Figure 6.1.2-1) enables users with command authority for a specific logical string to execute and monitor real-time ECL command directives. The command control window is the only mechanism for importing manual command directives. In addition to spacecraft and instrument, and command execution, the user by entering ECL directives in the Command Control window can access logical string processing, and spacecraft and ground telemetry monitoring.

Command directives, only executable via the Command Control window, include all directives preceded by / or CMD, as well as the Command subsystem directive SCMD%. Command directives entered in the command line of the Control or Procedure Control window will not execute. Refer to Section 9 for an in-depth discussion of logical string processing, spacecraft and ground telemetry monitoring, and commanding.

Prior to initiating the Command Control Window the user must request command authority via the TAKE COMMAND directive from the Control window (refer to Appendix A, ECL Directives, for additional information). If the user does request command authority a Command Monitor Window will be displayed. This tool allows the user to monitor command activity, the **CMD** text entry field is grayed out.

If you have command authority for a specific logical string, you can execute real-time command directives when you are connected to the string. Open the Command Control Window by clicking **Tools...** on the Control window and selecting **Command Control** from the list of tools in the Tool Selection dialog box. Alternately, type the appropriate ECL TOOL directive in the Control window command line (i.e., TOOL Command_Control). The Command Control dialog box (see Figure 6.1.2-2) opens. Enter the string and spacecraft ID in the dialog box and click **OK**.

The Command Control window contains a table displaying the date and execution time of the ECL directive, ATC location, directive type (manual (M), ground (G), or Procedure (P)), directive text, and directive status. The directive type refers to how the command was entered in the command control window, and how the command will be executed by the ground script controller. Manual (M) indicates the user entered the command or directive from the CMD input line and requires the user to click the send/cancel button, ground (G) indicates the command or directive was defined as part of a ground script and will execute based on the time stamp assigned to the directive, and Procedure (P) implies the command or directive is part of a procedure and will executed sequentially within the procedure without user intervention.

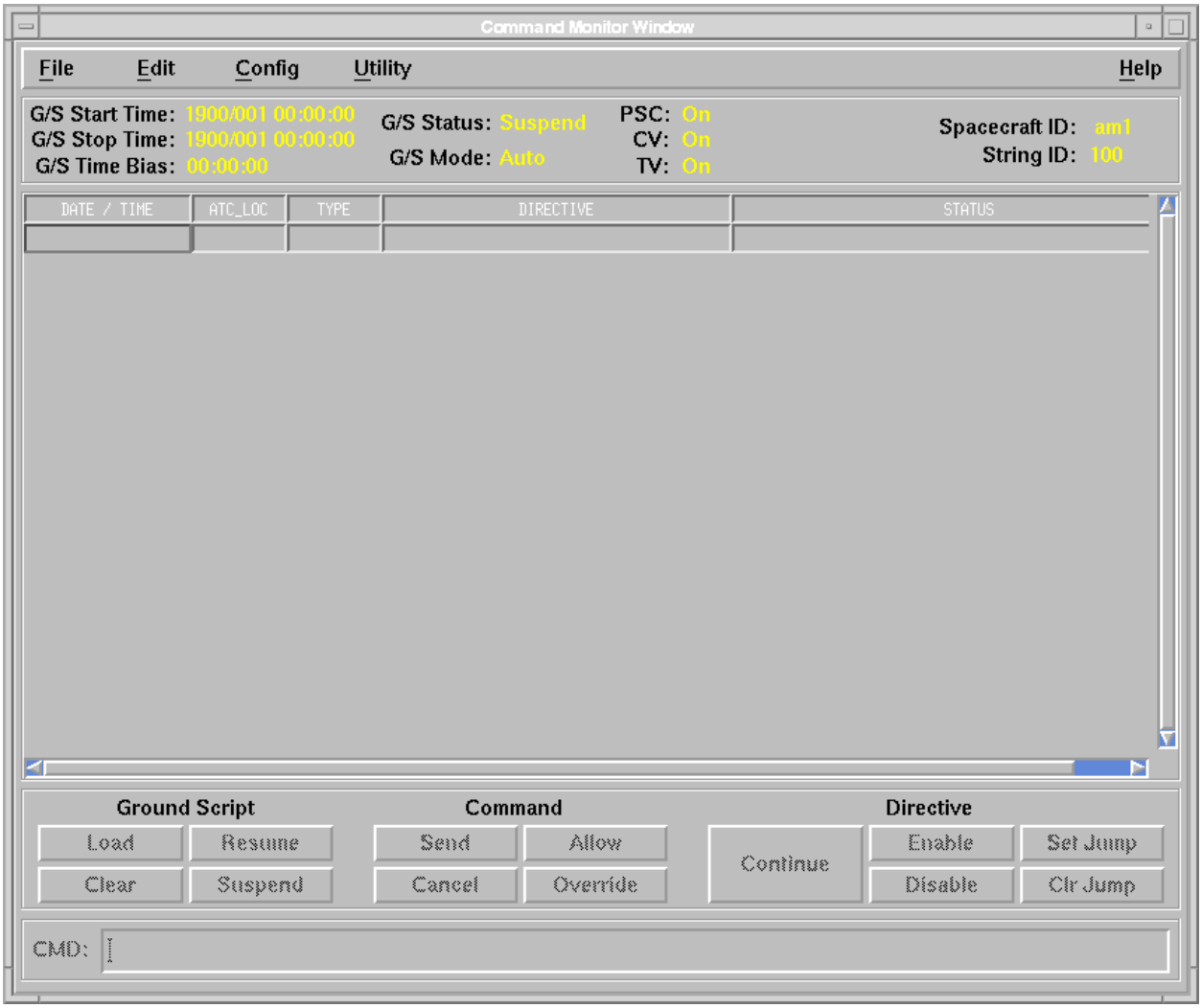

Figure 6.1.2-1. Command Control Window

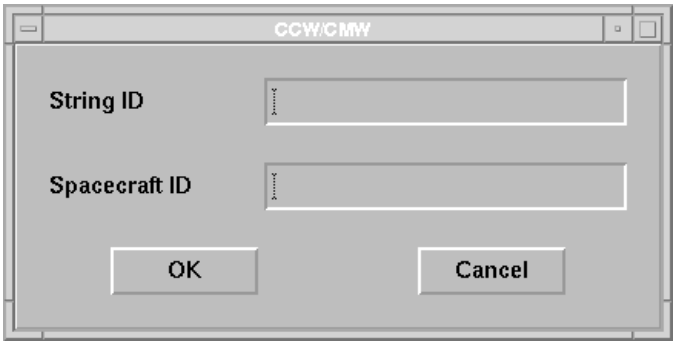

Figure 6.1.2-2. Command Control Dialog Box

To enter command directives:

Command directives may be entered manually, by typing the ECL CMD (/) directive followed by the command mnemonic with associated valid submnemonic parameter values into the **CMD** text entry field. Command directives are also entered in automatically via command procedures, ground procedures or ground scripts. Command directives include spacecraft commands and ground directives. Refer to Appendix A for a complete list of ECL directives and their syntax.

Before manually entering a command directive, ground scripts must be placed in a suspended mode. To suspend ground scripts, click **Suspend**. Type the directive in the CMD input line, press the enter key, the directive will be merged into the ground script display area in the Command Control window. Click **Resume** to continue ground script execution.

For additional information on creating and editing procedures, refer to the Procedure Builder Tool section. For instructions on entering command mnemonics, refer to the Real-Time Services section 9

Validation of command directives:

When the command is sent by clicking the send button, its syntax is checked and validated against the command pdb definitions. Valid commands with valid submnemonics are merged with the current set of ground script directives, time stamped, and executed as part of the ground script. If the submnemonic name in the command is invalid, a dialog box displays an error message. The **Status** column will indicate if the subfield value is out of range. If this is so, you may override the out of range value by clicking **Override** or cancel the directive by clicking **Cancel**.

6.1.3 Entering ECL from the Procedure Control Window

Refer to section 6.3.1 Executing Procedure, #7

6.2 ECL Procedures

An ECL procedure consists of a group of ECL directives that perform a specific task. The Procedure Builder tool provides the user the capability to create, edit, syntax check, validate, and save ECL procedures. ECL procedures are executed via the Procedure Control, Control, or Command Control windows by entering the START directive followed by the procedure name and any arguments to the procedure.

The Directive Builder Tool (see section 6.2.5) facilitates procedure building by allowing you to add directives to procedures without having to remember the exact syntax of each directive or command mnemonic. The Procedure Control window (see section 6.3.1) enables you to start a procedure as well as control and monitor its execution.

Procedures containing spacecraft commands or ground directives must be executed from the Command Control window (see section 6.3.1). Appendix A provides a complete list of ECL directives and their syntax, as well as information about using variables in a procedure.

6.2.1 Procedure Builder Tool

On the Control window, click **Tools...** to open the Tool Selection dialog box. Select **Procedure Builder** from the list of tools or type the appropriate ECL TOOL Procedure_Builder directive in the Control window command line.

The Procedure Builder window consists of six regions (Figure 6.2.1-1):

1. **Menu bar**. File, Edit and Tools menus.
2. **Procedure file name and type**. Procedure types include Activity, Command, Emergency, Ground, Local and User Defined.
3. **Procedure text entry area**. Box where the text of a procedure is entered.
4. **Status line**. Provides status of file operations.
5. **Go To text box**. Refer to a specific line in the procedure by entering the line number in the Go To text box.
6. **Syntax and validate buttons and indicators**. Perform syntax checking and validation.

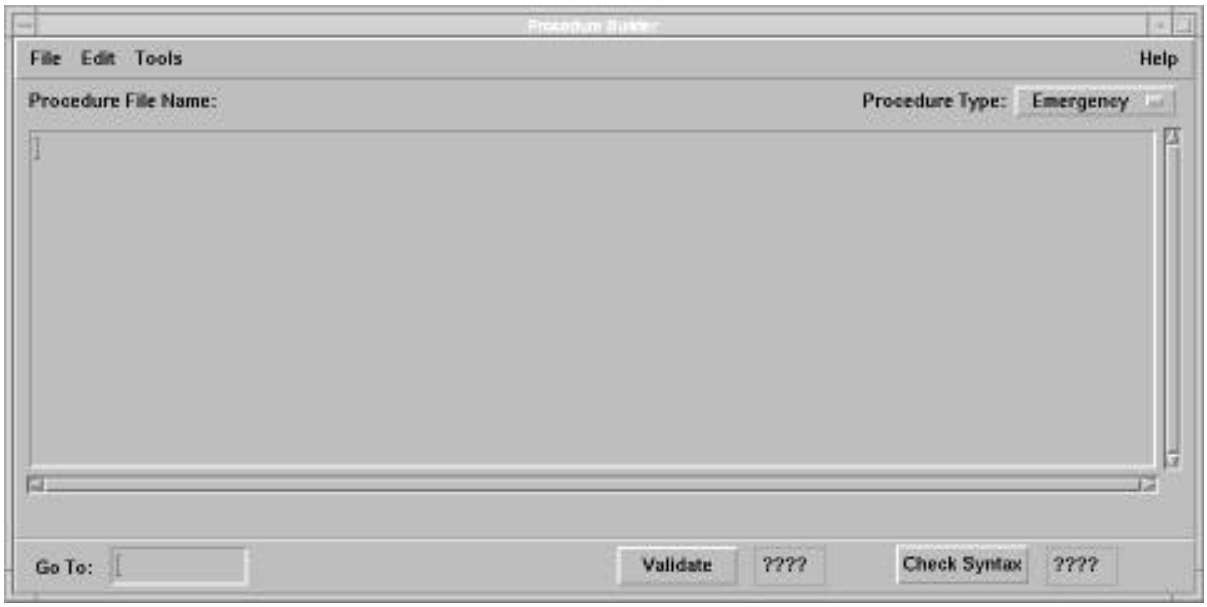

Figure 6.2.1-1. Procedure Builder Window

To select the procedure type:

Procedures are categorized into various procedure types based on the functions they perform. Some procedure types are restricted in terms of the type of directives they may contain (command or non-command). When the user validates the procedure the software checks the procedure type. If the procedure type is not defined based on the criteria below, the procedure will fail validation

(see **To perform procedure syntax checking and validation** below). There are also limitations when executing the various procedure types. Local procedures can be executed via the Control Window, Ground procedures require ground authority and can be executed via Control Window, Procedure Control Window or Command Control Window. Command and Emergency procedures require command authority and can only be executed via Command Control Window. (Note: All procedure types can be executed from the Command Control Window) In addition, procedure types which may contain one or more command directives may be restricted to ground or spacecraft commands as explained below in items a. through f.

1. **Activity**. Unrestricted.
2. **Command**. Contains at least one spacecraft command.
3. **Emergency**. Contains at least one spacecraft command.
4. **Ground**. Contains at least one ground directive..
5. **Local**. Contains no spacecraft commands or ground directives.
6. **User Defined**. Unrestricted.

To create a new procedure or open an existing procedure:

1. **Create a new procedure**.

   Select **New** under the File menu of the Procedure Builder window. An ECL procedure template is displayed in the Procedure text entry area.

   or

   Open an existing procedure.

   Select **Open** under the File menu of the Procedure Builder window. The File Selection dialog opens (see Figure 6.2.1-2). Click **User Dir** to display the default directory for user defined procedures or **System Dir** for the directory of System procedures. To filter files, enter filter criteria, such as a path or file extension in the **Filter** text box and click **Filter**. Select the file to open and click **OK**. The selected procedure file opens.

2. **Select the procedure type**.

   Select the procedure type from the Procedure Type pull-down menu: **Activity**, **Command**, **Emergency**, **Ground**, **Local** or **User Defined**.

3. **Enter directives in the procedure**.

   To enter directives manually place the cursor in the procedure text entry area and begin entering directives, or use the Directive Builder Tool (see section 6.2.5). As text is entered, the Check Syntax and Validate indicators change to **????** to reflect the fact that the status of directives added to the procedure is unknown, since they have not been validated or syntax checked.

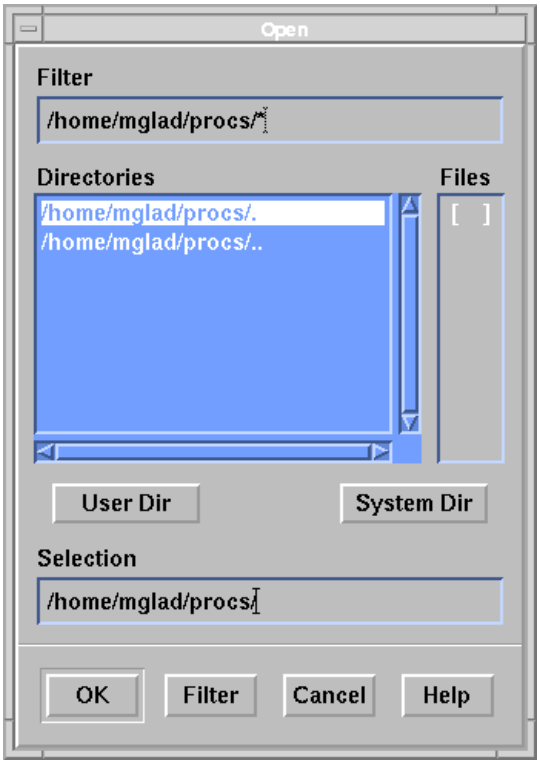

Figure 6.2.1-2. File Selection Dialog Box

4. **Edit text in the procedure**.

   Use the **Cut**, **Copy**, **Paste**, and **Delete** Edit menu options to edit text in the procedure text entry area.

5. **Search for or replace text in the procedure**.

   Select **Find/Replace** under the Edit menu. The Find/Replace dialog box opens (see Figure 6.2.1-3).

   a. **Replace text**.

      Type the text to be replaced in the Find box. Enter the replacement text in the Replace box or leave the Replace box blank. Click **Replace** to replace the next occurrence of the text or **Replace All** to replace all occurrences of the text.

   b. **Find text**.

      Type the text to be found in the Find box. Click **Find Next**. The next occurrence of the Find text is located and highlighted.

   c. **Close the Find/Replace dialog box**.

      Click **Cancel**. The dialog box closes. Any text replacements made through **Replace** or **Replace All** remain in effect.

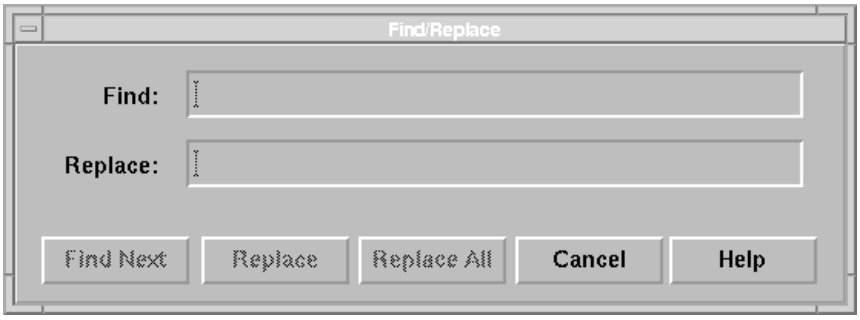

Figure 6.2.1-3. Find/Replace Dialog Box

To move the cursor to a specific procedure line:

Move the cursor to a specific line in the procedure text window, and click mouse button, or enter the line number in the **Go To** text entry field in the bottom left corner of the Procedure Builder window.

To perform procedure syntax checking and validation:

Click **Check Syntax** to determine if the syntax of directives in the procedure is correct. If the procedures syntax is correct, the Check Syntax text box will read PASS. If the procedure contains incorrect syntax, the Check Syntax text box will read FAIL and the first incorrect directive will be flagged in the Status line along with the line number. Repeat this process until procedure is successfully passes.

Click the **Validate** button to perform command-level constraint checking. If the submnemonics are valid for the mnemonics they are associated with in the procedure, and the procedure definition does not violate the constraint definition for the specified command mnemonics, the Validate text box will read PASS. If the submnemoics are invalid for the mnemonics they are associated with, or a constraint violation has occurred the Validate text box will read FAIL. The invalid submnemoics will be flagged in the Status line.

Procedures must be syntax checked and validated before they are executed. If a procedure has not been syntax checked, clicking **Validate** will syntax check and then validate the procedure.

To save a new procedure:

Select **Save** from the File menu on the Procedure Builder window. The File Selection dialog box opens (see Figure 6.2.1-2). By default, all procedures are saved in the default directory for user-defined procedures, the user's home directory (i.e., /home/jsmith/procs).

To save an existing procedure:

To save an existing procedure under its current file name, select **Save** from the Procedure Builder File menu. To save a procedure with a new name, select **Save As** from the File menu. The File Selection dialog box opens (see Figure 6.2.1-2).

If you do not enter or select a path in the File Selection dialog box, the procedure is saved in the default directory for user-defined procedures, the user's home directory. To navigate through directories in the directories list, specify a path or enter filter criteria in the Filter box and click

Filter. Procedures can be saved to the System directory, by clicking System, the directory path will be displayed (i.e., /fos/test/am1/procs), enter the procedure name in the selection text box and click OK.

To overwrite an existing procedure:

Enter a file name in the "Selection" list box or overwrite an existing procedure by selecting it from the list of files. Click **OK** to save the procedure with the name and path specified in the "Selection" list box. The File Selection dialog box closes.

6.2.2 Insert a Procedure into an Open Procedure

Place the cursor at the location in the procedure text window where the insertion will occur. Select **Insert** under the File menu. The File Selection dialog box opens (see Figure 6.2.1-2). Type the path in the Filter text box and select the name of the procedure to be inserted. Click **OK** to insert the procedure at the cursor location in the open file. The procedure is inserted and the File Selection dialog box closes.

6.2.3 Delete a Procedure

Select **Delete** from the File menu on the Procedure Builder window. The File Selection dialog box opens (see Figure 6.2.1-2). Select a procedure to delete and click **OK**. A dialog box opens to confirm the delete operation. Click **Yes** to delete the procedure or **No** to leave the procedure in the file directory. The File Selection and confirmation dialog boxes close and the status of the delete operation is displayed in the Status line.

6.2.4 Print a Procedure

Once you have opened the file to be printed, select **Print** under the File menu of the Procedure Builder window. The procedure text is sent to the printer.

6.2.5 Add Directives, Commands, or Telemetry Mnemonics to Procedures with the Directive Builder Tool

Place the cursor in the location where you wish to insert the directive, or mnemonic in the open procedure.

To open the Directive Builder:

Open the Directive Builder Tool (see Figure 6.2.5-1) by selecting **Directive Builder...** from the Procedure Builder Tools menu. The Directive Builder tool enables you to build and insert a directive, command mnemonic, or mnemonic into a procedure without having to remember its exact syntax.

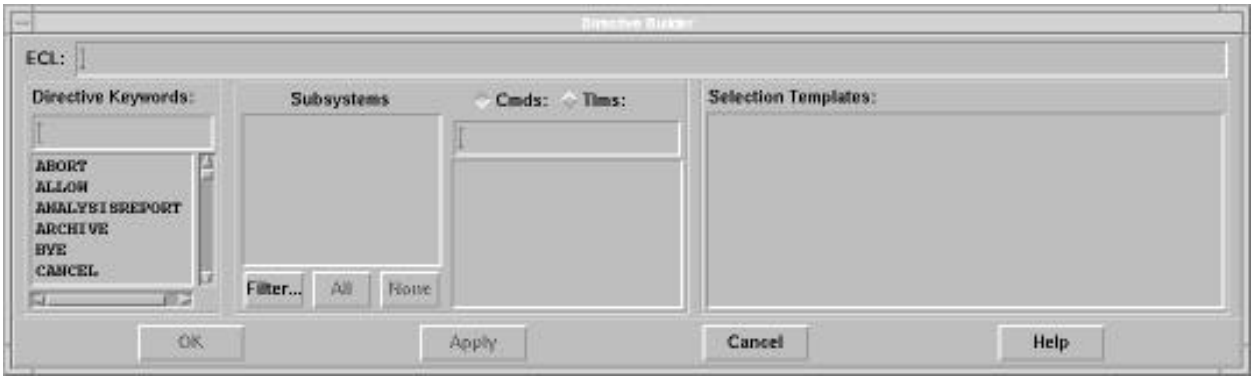

Figure 6.2.5-1. Directive Builder Window

To insert a directive into a procedure:

1. **Select a directive from the list of directive keywords or type a keyword in the text box.**

   As you type a keyword in the text box, the keyword list scrolls to the first matching keyword entry.

   The subdirectives associated with the selected directive are displayed in the "Selection Templates" list box. For example, if you select the PAGE directive keyword, the subdirectives CLOSE, DELETE, FREEZE, UNFREEZE, ICONIFY, etc., will be listed in the "Selection Templates" list box.

2. **Double click a directive keyword with the left mouse button to copy it into the ECL command line**.

   Double click a subdirective with the left mouse button to append it to the directive in the ECL command line.

3. **Insert the directive into the procedure and leave the Directive Builder window open.**

   Click **Apply** to insert the directive into the procedure at the current cursor location.

   or

   Insert the directive into the procedure and close the Directive Builder window.

   Click **OK** to insert the directive into the procedure at the current cursor location and close the Directive Builder window.

To insert a command mnemonic into a procedure:

1. **List all command mnemonics.**

   Click the **Cmds** toggle button to obtain a list all command mnemonics from which the user can select from.

2. **Filter command mnemonics**.

   Click **Filter** to create spacecraft subsystem, or instrument mnemonic. The Selection Filter dialog box opens (see Figure 6.2.5-2). Create a filter by selecting a spacecraft under "Spacecraft" and a spacecraft subsystem, or instrument under "Instrument" on the Selection Filter dialog box. Move the newly created filters to the "Selected" list box by clicking the "Scroll Forward" arrow. Defined filters are displayed in the "Subsystem" list box as a scrolling list of option buttons on the directive builder window once OK is selected on the filter dialog box (e.g., AM1_AST for AM1 ASTER).

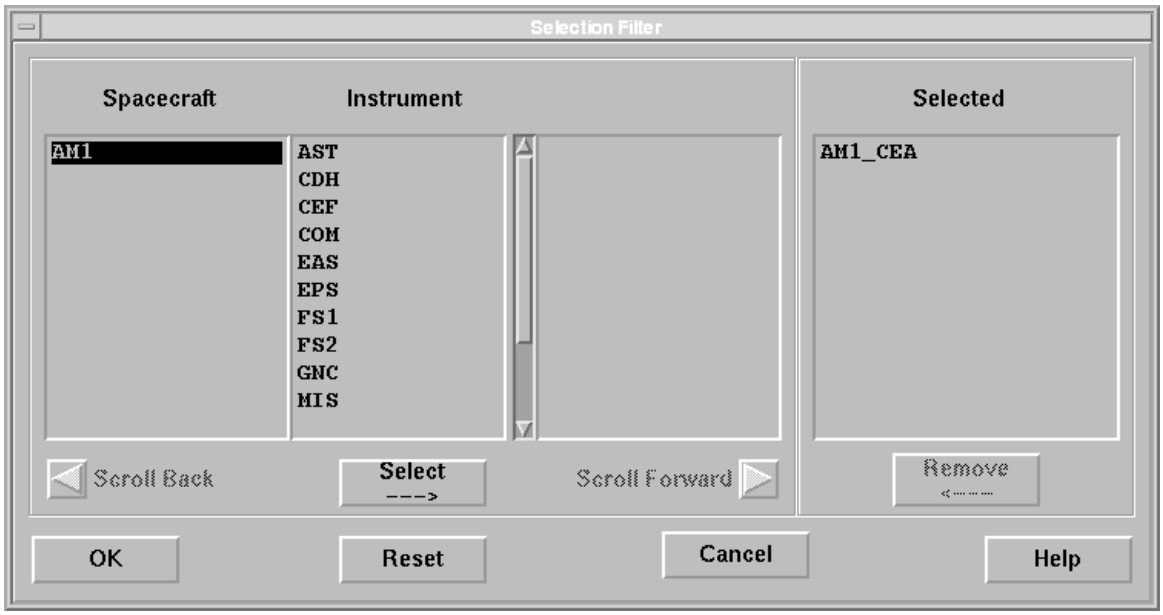

Figure 6.2.5-2. Selection Filter Dialog Box

3. **Select filters**.

   Click on one or more filter(s) to display the command mnemonics associated with the filter(s) from Subsystems list box.

4. **Display the submnemonics associated with a command mnemonic**.

   Click a command mnemonic to display the submnemonics associated with the command in the "Selection Templates" list box. For example, if you select the AST_SET_S_PULSE_PARITY command, the submnemonics PARITY and PULSE as well as their maximum, minimum, and default values are displayed in the "Selection Templates" list box.

NOTE

As you type a command mnemonic in the text box, the list scrolls to the first command matching your entry.

5. **Copy a command mnemonic to the ECL command line**.

   Double-click a command mnemonic with the left mouse button to copy it to the ECL command line. Append a subdirective to the directive in the ECL command line by double clicking it with the left mouse button. Edit the directive by adding user-defined variables or other customization prior to inserting the directive into the procedure text.

6. **Insert the directive into the procedure and leave the Directive Builder window open.**

   Click **Apply** to insert the directive at the current cursor location.

   or

   Insert the directive into the procedure and close the Directive Builder window.

   Click **OK** to insert the directive at the current cursor location and close the Directive Builder window.

To insert a telemetry mnemonic into a procedure:

A directive may include telemetry mnemonics in order to refer to its value in the directive.

1. **List all telemetry mnemonics**.

   Click **Tlms** toggle button to list all telemetry mnemonics.

2. **Create filters for telemetry mnemonics**.

   Click **Filter** to create spacecraft subsystem, or instrument, for telemetry mnemonics via the Selection Filter dialog box. Defined filters are displayed in the Subsystem window as a scrolling list of option buttons (e.g., AM1_AST for AM1 ASTER).

3. **Select one or more filters**.

   The telemetry mnemonics associated with the filter(s) are displayed.

4. **Select one of the mnemonics from the list**.

   The limit sets or discrete values associated with that mnemonic are displayed in the "Selection Templates" list box in the Directive Builder window. Note that the box above the list of mnemonics may be used to find a mnemonic. As you type in the box, the list scrolls to the first mnemonic matching your entry.

5. **Copy a mnemonic to the command line**.

   Double-click a mnemonic with the left mouse button to copy it to the ECL command line.

6. **Insert the directive into the procedure and leave the Directive Builder open.**

   Click **Apply** to insert the directive into the procedure at the current cursor location.

   or

   Insert the directive into the procedure and close the Directive Builder.

   Click **OK** to insert the directive into the procedure at the current cursor location and close the Directive Builder window.

6.2.6 View Procedure Meta Data

Procedure Meta Data provides summary data concerning an open procedure. The meta data includes the name, type, latest syntax and validation status, location (path), authors username, the username of the individual who last modified the procedure, creation date, and last modified date. The procedure Meta Data is only updated when the procedure is saved, hence the Meta Data only reflects the saved changes.

Select **Meta Data...** under the Tools menu of the Procedure Builder window to display the Meta Data dialog window for the open procedure (see Figure 6.2.6-1). Click **Close** to close the Meta Data dialog box.

6.2.7 Exit the Procedure Builder

To save a procedure before exiting, see section 6.2.1. Select **Quit** under the File menu to close the Procedure Builder window.

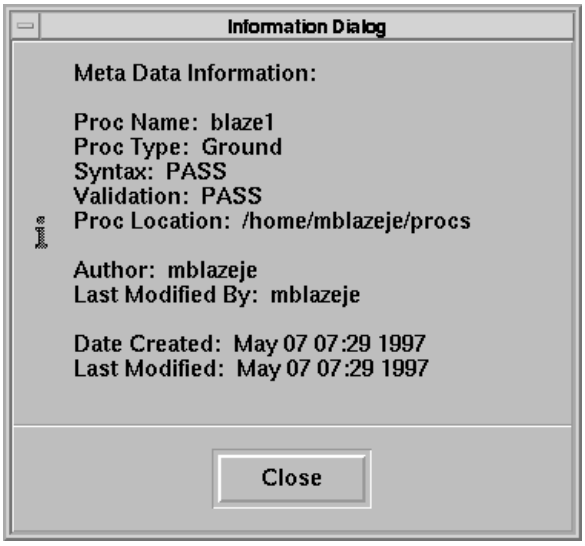

Figure. 6.2.6-1. Meta Data Dialog Box

6.3 Execute a Procedure

You can start a procedure from the Procedure Control, Control or Command Control window. The Procedure Control window enables you to closely monitor and exercise a greater degree of control over procedure execution than the Control or Command Control window. However, a procedures containing one or more spacecraft commands or ground directives may only be started from the Command Control window,

6.3.1 Execute a Procedure from the Procedure Control Window

On the Control window (see Figure 6.1.1-1), click **Tools...** to open the Tool Selection dialog box. Select **Procedure Control** from the list of tools or type the ECL TOOL directive, TOOL Procdure_Builder in the Control window command line.

The Procedure Control window (see Figure 6.3.1-1) enables you to start a procedure, monitor and control its execution (refer to section 6.2.1 for the types of procedures). The status of each directive in the procedure is displayed and updated in the Procedure Control window as the procedure executes.

1. **Open a procedure**.

   Select **Open** under the File menu of the Procedure Control window. The Open File dialog box opens. Select the file to be opened and click **OK**.

2. **Find text in a suspended or inactive procedure**.

   Click **Find** to find text in the open procedure. The Find dialog box opens. Enter text to search for in the Find box and click **OK**. The Find dialog box closes and next directive containing the find text is highlighted.

3. **Start a procedure.**

   Open a procedure by selecting **Open** from the File menu of the Procedure Control window. Click **Resume** to start the open procedure.

4. **Monitor execution of a procedure.**

   The currently executing directive flashes in the Procedure Control window. The status column reads “active.”

5. **Designate directives to be skipped**.

   Click **Suspend** to stop execution of the procedure. Set a jump point by placing the cursor on the last line containing a directive you want to skip and clicking **Set Jump**. The status column adjacent to the directives to be skipped changes to “Skip”. Resume execution of the procedure by clicking **Resume**. The directives up to and including the directive on the line where you set the jump point will be skipped. To remove a jump point, click **Clear Jump**. A procedure may contain only one jump point.

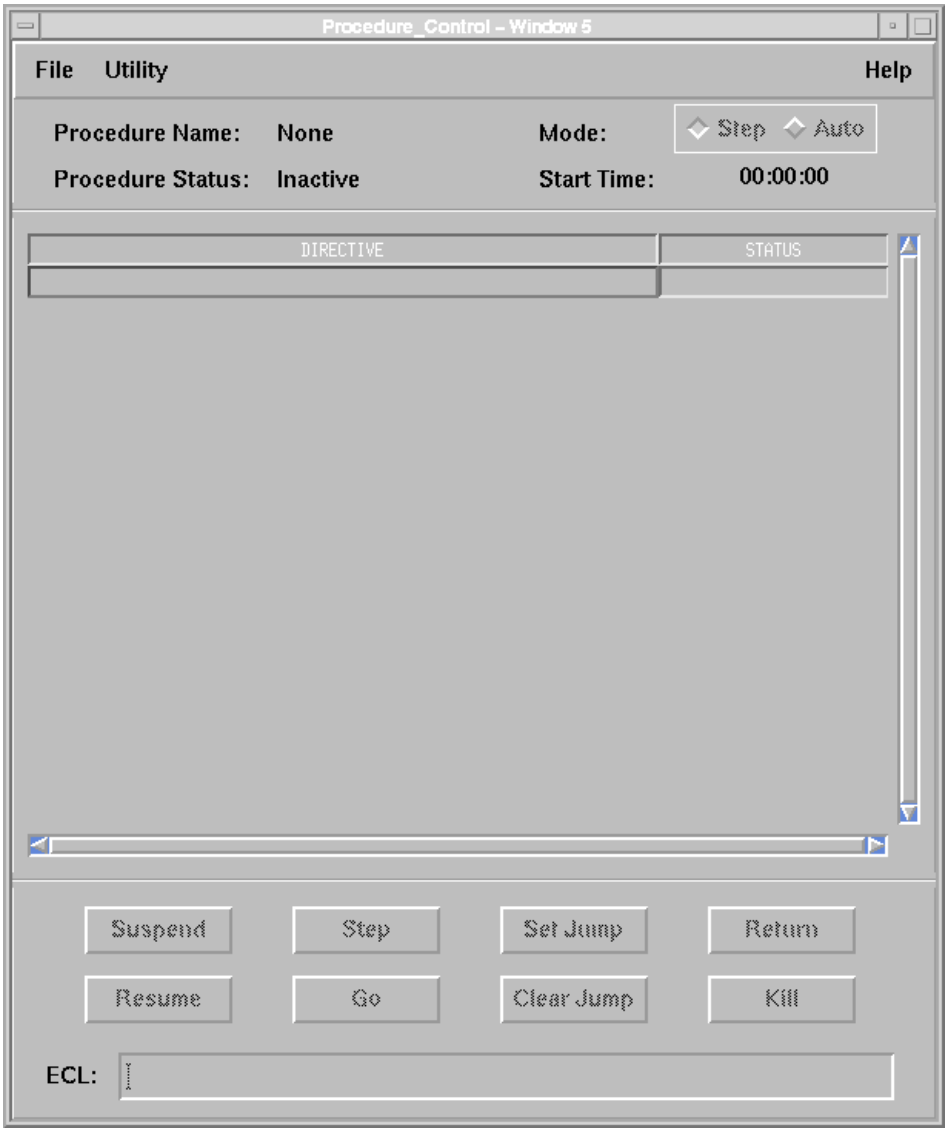

Figure 6.3.1-1. Procedure Control Window

6. **Override the WAIT directive**.

   If the current directive is the WAIT directive, you can override the waiting period and execute the next directive immediately by clicking **Go**.

7. **Enter manual, non-command directives in the ECL command line.**

   Only Local ECL directives, or ground directives (see section 6.1 for definition of local and ground directives), can be entered in the ECL command line while a procedure is active or inactive. Position the cursor on the line in the procedure text area where you wish to insert the directive. Enter the directive and press the <Return> key.

8. **Suspend and resume execution of a procedure.**

   While the procedure is executing, click **Suspend**. Once the active directive has executed, the procedure is suspended. Press the **Resume** button to continue execution of the procedure.

9. **Step through a procedure one directive at a time.**

   While the procedure is executing, select **Step** at the top of the Procedure Control window. Execution of the procedure is suspended and the mode changes from Auto to Step. The next directive in the procedure to be executed flashes in the screen but will not execute until you click **Step**. While the procedure is in Step mode, you must click **Step** to start each successive directive in the procedure. To return to Auto mode, click the Auto toggle box. The next directive in the procedure automatically executes.

10. **Stop execution of a nested procedure and continue execution of the parent procedure.**

    While a nested procedure (a procedure called by another procedure) is active, click **Suspend**. The nested procedure stops executing. To continue executing the parent procedure, click **Return**. The parent procedure will continue executing, commencing with the directive after the directive which called the nested procedure.

11. **Terminate execution of a procedure**.

    Click **Suspend** to suspend the procedure. Click **Kill** to terminate the procedure.

6.3.2 Execute a Procedure from the Control Window

Local and Ground procedures can be executed from the Control Window, however ground procedures require ground authority (refer to Section 6.1.1). Enter the START directive in the ECL command line of the Control window (see Figure 6.1.1-1) followed by the procedure name, for example START *proc name*. The START directive is treated as a manual directive that must be confirmed prior to execution. The user directory is checked first for the procedure name entered in the START directive. If the procedure is not found, a search is performed in the system directory. The procedure is retrieved from the user or system directory and the procedure directives are executed in the background. The status of the procedure execution may be monitored through event messages on the Event Display window.

The TIME directive may be appended to the START directive to delay the start of execution until a specified time, for example TIME=*HH:MM:SS.*

6.3.3 Execute a Procedure from the Command Control Window

Obtain command authority via the TAKE COMMAND directive (refer to Section 9 for additional information). On the Control window (see Figure 6.1.1-1), click **Tools...** to open the Tool Selection dialog box. Select **Command** Ground, Command and Emergency procedures can be executed from the Command Control Window **Control** from the list of tools or type the ECL TOOL directive in the Control window command line.

Enter the START directive in the CMD command line, for example START *proc name.* The START directive is treated as a manual directive that must be confirmed prior to execution. After the START directive is confirmed, it will be inserted into the command table section of the Command Control window along with any other ground script directives contained in the procedure. Each procedure directive executes as part of the ground script with appropriate status being posted in the Command Control window. A directive with the keyword time may be appended to the START directive to delay the start of execution until a specified time, for example TIME=*YYYY/day HH:MM:SS.*

6.3.4 Procedure Arguments

A procedure can accept optional arguments defined when the procedure is created (refer to Appendix A). Each argument is a specific type (integer, real, character). When the procedure is started, initial argument values are specified in the START directive:

START *ABC* (*1*,*2*)

Procedure ABC must begin with a prototype statement (see Appendix A, section A.1.2) which defines it as accepting two arguments, both integers as follows:

PROC *ABC* (int $arg1, int $arg2)

In this example, arg1 will be assigned the value 1 and arg2 will be assigned the value 2. The arg1 and arg2 arguments are used in the same manner as variables within the procedure (i.e., their values may be referenced or updated). Refer to Appendix A for additional information concerning variables within procedures.

6.4 Submit a Command Request to the Operations Controller

The Command Request window (Figure 6.4-1) lists command requests submitted to the Operations Controller by members of the FOT or by ISTs connected to the EOC. Pressing the **Create...** button on the Command Request window opens the Command Request Creation window (Figure 6.4-2) which enables ISTs in the connected mode as well as FOT operators to submit requests for the Operations Controller to send command procedures, real-time commands or to activate a relative time command sequence. The Operations Controller's review of command requests is discussed in Section 6.5.

1. **Open the Command Request window**.

   Select **Command_Request** from the Tools menu of the Control or Mini-Control windows.

2. **Create a new command request or edit and existing request**.

   To create a new command request, click on the **Create...** button on the Command Request window (Figure 6.4-1) to open the Command Request Creation window (Figure 6.4-2). On the Command Request Creation window, fill in the **Subject** and **Instruction** text fields.

   or

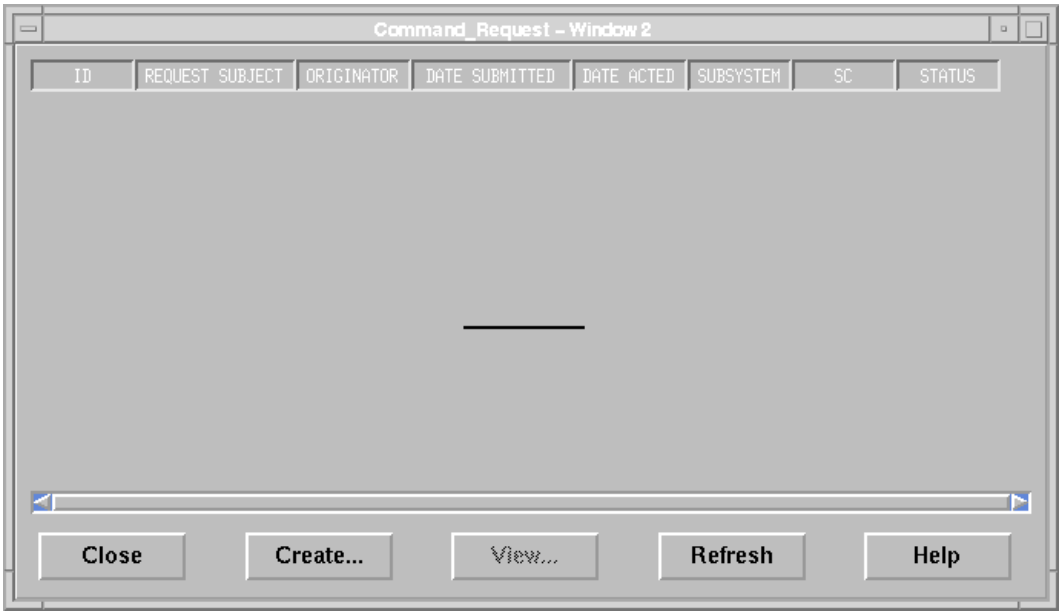

Figure 6.4-1. Command Request Window

To edit an existing command request, select a command request on the Command Request window and click on the **Create…** button to open the Command Request Creation window. If desired edit the **Subject** and **Instruction** text fields.

3. **Add a procedure to the command request**.

   At the time of this writing, adding a procedure to a command request via the **Add Proc…** button is not an available capability. This section of the document will be updated once the capability is made available.

4. **If desired, add a directive to the command request**.

   Click on the **Add Cmds…** button on the Command Request Creation window to open the Directive Builder (Figure 6.4-3). Build an ECL directive by following the procedures described in paragraph 6.2 of this section. If desired, real-time commands may be included in through the Directive Builder. Once the directive is entered, click on the **OK** button to close the Directive Builder dialog and insert the directive into the table in the Command Request Creation window.

5. **Submit the command request to the Operations Controller**.

   Click on the **Submit** button in the Command Request Creation window to submit the command request to the Operations Controller. The Command Request Creation window closes, revealing the Command Request window. Press the **Refresh** button to refresh the Status window and display the newly submitted command request and its status. Highlight the request's status and click on the **View…** button to open the Command Request Evaluation window (Figure 6.4-4). If the command was rejected, click on the **Reason** button to display the explanation for the rejection in the Command Request Rejection dialog box (Figure 6.4-5).

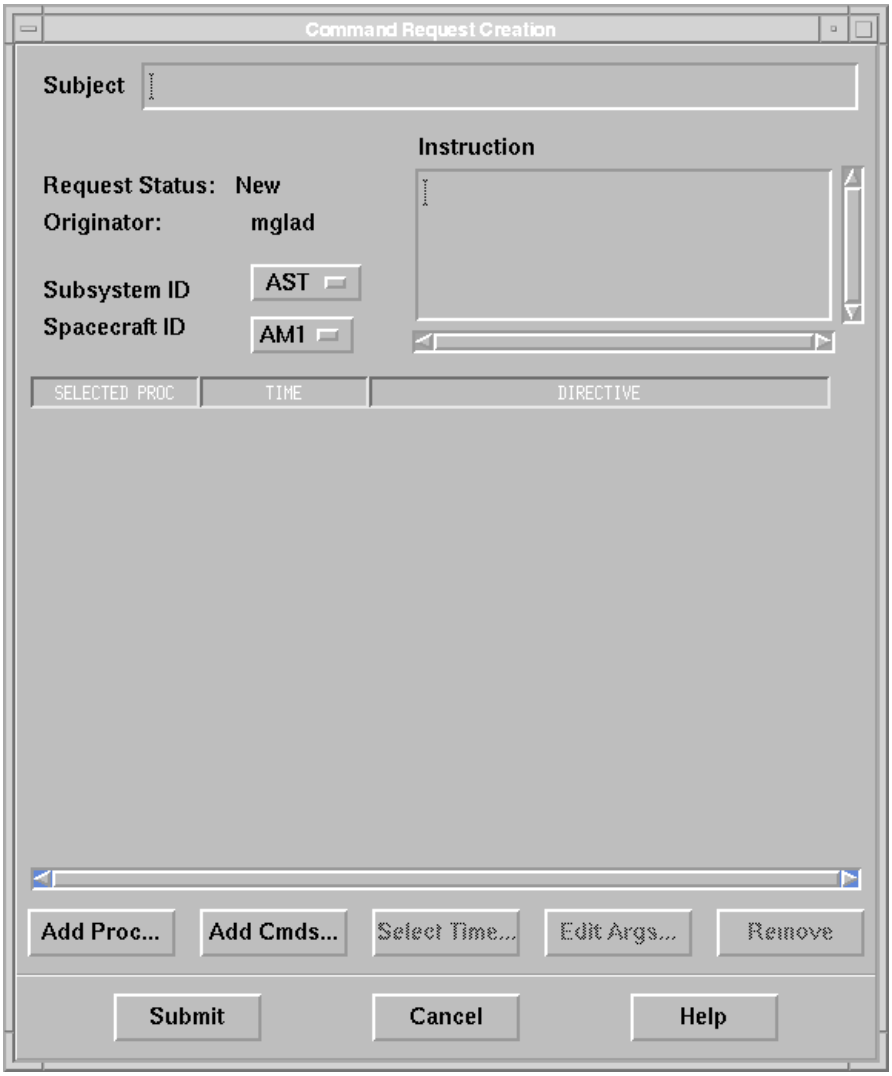

Figure 6.4-2. Command Request Creation Window

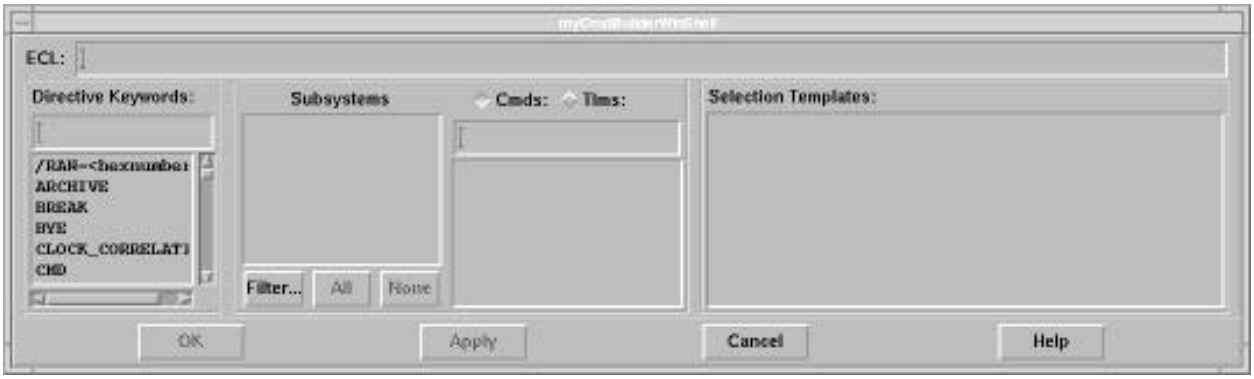

Figure 6.4-3. Directive Builder Window

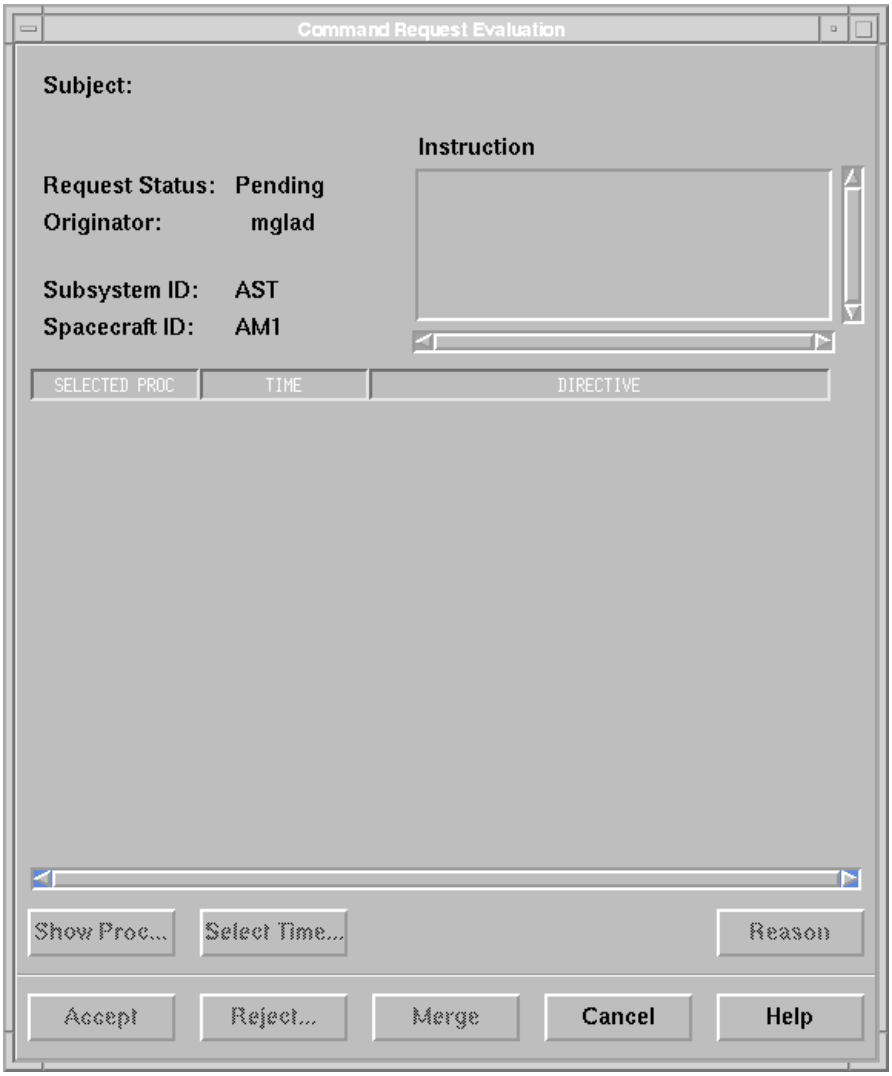

Figure 6.4-4. Command Request Evaluation Window

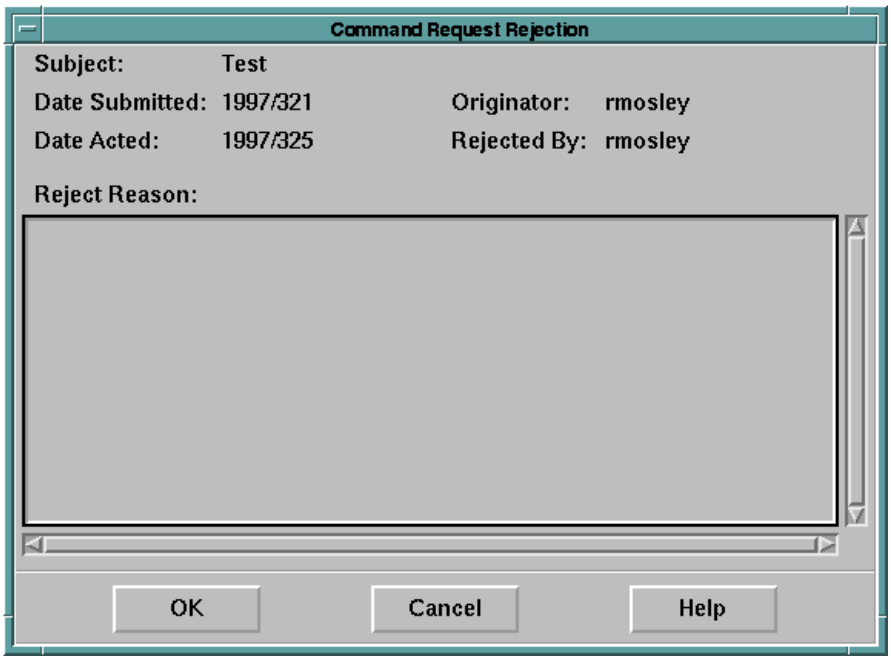

Figure 6.4-5. Command Request Rejection Dialog Box

6. Close the Command Request window.

   Click on the **Close** button.

6.5 Evaluate a Command Request

In order to evaluate command requests submitted by the ISTs and members of the FOT, you must be authorized to assume the Operations Controller role and must open the Command Request window in the Operations Controller role.

1. **Open the Command Request window**.

   Select **Command_Request** from the Tools menu of the Control or Mini-Control windows. The Command Request window opens (Figure 6.5-1).

2. **Examine a submitted command request**.

   Select the command request from the table and press the **View...** button to open the Command Request Evaluation window (Figure 6.5-2).

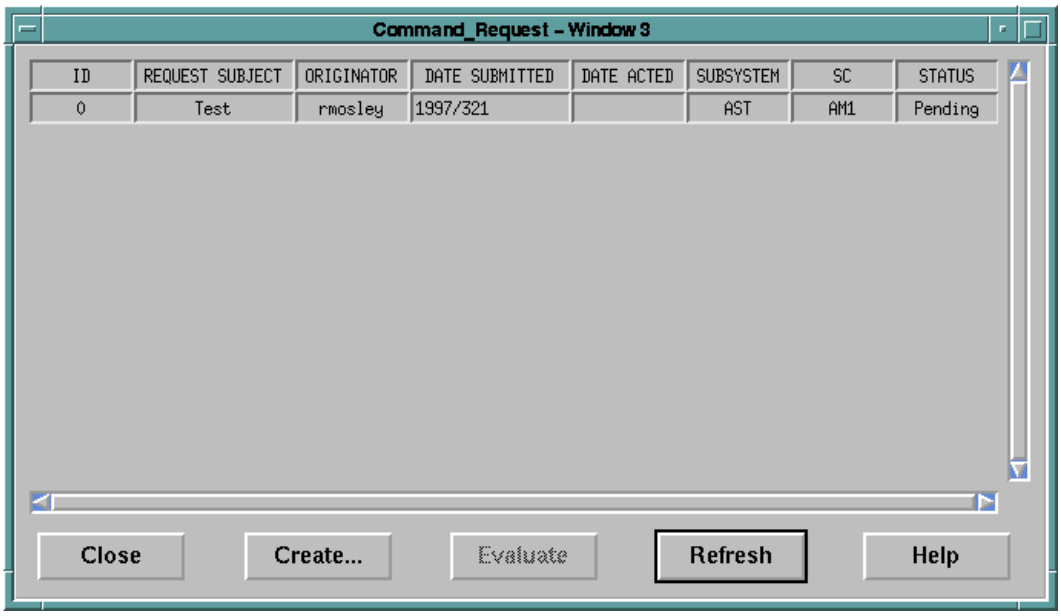

Figure 6.5-1. Command Request Window

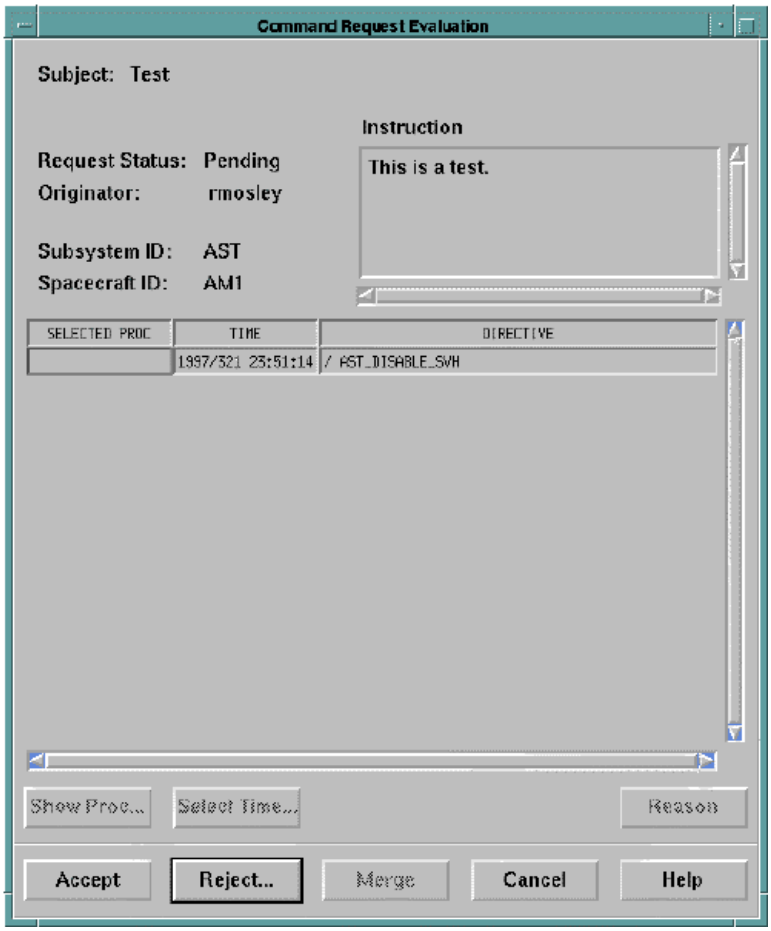

Figure 6.5-2. Command Request Evaluation Window

3. **Accept the command request**.

   Press the **Accept** button to accept the request. The Command Request Handler window opens, indicating notification was sent to the originator.

   Press the **Merge** button to merge the command request and close the Command Request Evaluation window.

   or

   Reject the command request.

   Press the **Reject…** button to reject the request. The Rejection dialog box opens (Figure 6.5-3). Enter the reason(s) for the rejection and click **OK** to close the Rejection dialog box. Click the **Cancel** button to close the Command Request Evaluation window.

4. **Update the status displayed for the command request**.

   Press the **Refresh** button to display the updated status for the command request in the status column of the Command Request window.

5. **Close the Command Request window**.

   Click the **Close** button.

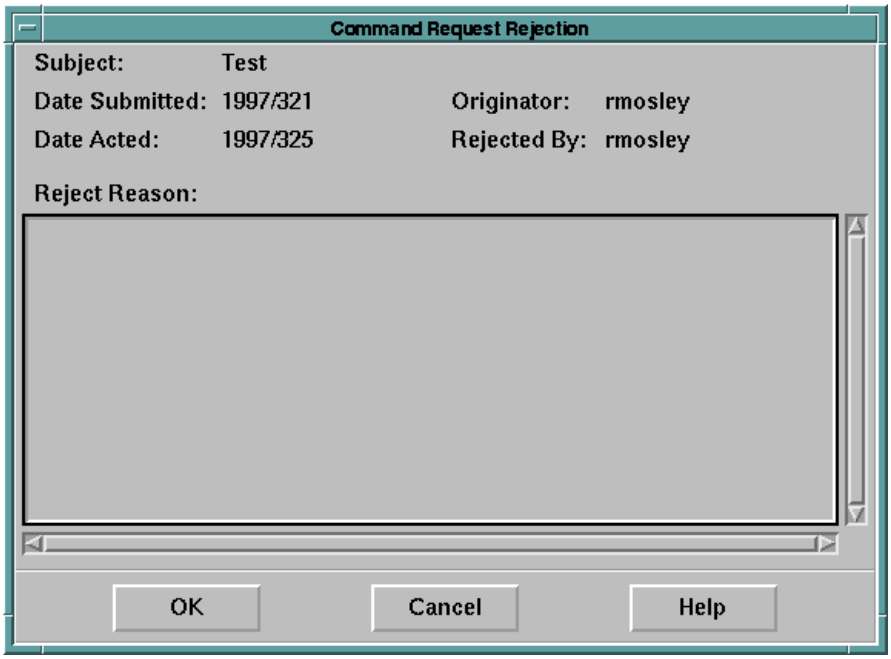

Figure 6.5-3. Rejection Dialog Box

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